

**Masaryk University
Faculty of Economics and Administration
Department of Finance
and
Institute for Financial Market**

European Financial Systems 2018

**Proceedings
of the 15th International
Scientific Conference**

June 25-26, 2018

Brno, Czech Republic

Suggested citation:

AUTHOR, A. Title of the paper. In: *European Financial Systems 2018. Proceedings of the 15th International Scientific Conference*, Brno: Masaryk University, 2018, pp. xx-xx. ISBN 978-80-210-8980-8 (for print version Proceeding), ISBN 978-80-210-8981-5 (for on-line version Proceeding).

Editors:

Josef Nešleha
Filip Hampl
Miroslav Svoboda

© 2018 Masarykova univerzita

ISBN 978-80-210-8980-8 (for print version Proceeding),

ISBN 978-80-210-8981-5 (for on-line version Proceeding).

All published papers have been reviewed before publishing. The proceedings have not been amended or proofread. Editors are not responsible for the language used in the papers.

Program Committee of the Conference

Chair:

Ing. Petr Valouch, Ph.D. (Masaryk University)

Members:

Prof. Dr. Ing. Dana Dluhošová (VŠB – Technical University of Ostrava, Czech Republic)

Prof. Ing. Danuše Nerudová, Ph.D. (Mendel University Brno, Czech Republic)

Prof. Ing. Eva Horvátová, PhD (University of Economics in Bratislava, Slovak Republic)

Prof. Ing. Juraj Němec, CSc. (Matej Bel University, Slovak Republic)

Prof. Ing. Erika Pastoráková, PhD. (University of Economics in Bratislava)

Prof. Dr. Svend Reuse (FOM Hochschule für Oekonomie und Management, Federal Republic of Germany)

Assoc. Prof. Ing. Petr Dvořák, Ph.D. (University of Economics in Prague, Czech Republic)

Univ.Dož.Mag. Dr. Peter R. Haiss, PhD (Lecturer, Vienna University of Economics and Business, Republic of Austria)

Assoc. Prof. Ing. Peter Krištofík, Ph.D. (Matej Bel University, Slovak Republic)

Assoc. Prof. Antonin Rusek, PhD. (Susquehanna University, USA)

Assoc. Prof. Ing. Jaroslav Sedláček, CSc. (Masaryk University Brno, Czech Republic)

Assoc. Prof. Jitka Veselá, Ph.D. (University of Economics in Prague, Czech Republic)

Assoc. Prof. Ing. Eva Vávrová, Ph.D. (Masaryk University Brno, Czech Republic)

Assoc. Prof. Ing. Jana Vodáková, Ph.D. (University of Defense Brno, Czech Republic)

Dr. Piotr Tworek (University of Economics in Katowice, Republic of Poland)

Organizing Committee of the Conference

Chair:

Ing. Jan Krajíček, Ph.D.

Members:

Ing. Filip Hampl

Ing. Josef Nešleha

Ing. Tomáš Plíhal

Mgr. Zuzana Rakovská

Mgr. Miroslav Svoboda

Mgr. Ing. Pavel Sedláček

Ing. Martina Sponerová

Conference website: www.efs.econ.muni.cz

PREFACE

Dear readers,

It is my pleasure to introduce you a collection of papers from the 15th annual international scientific conference The European Financial Systems 2018 organized annually by Department of Finance of the Faculty of Economics and Administration, Masaryk University in Brno, Czech Republic. This year's conference was focused especially on the current issues related to accounting, banking sector, insurance, financial literacy, financial law, new regulations of financial markets, different tax systems, corporate finance, cryptocurrencies, public finance and financing of non-profit organizations.

Since the collection of papers presents the latest scientific knowledge in this area, I believe you will get a number of new insights usable both for your scientific, and educational or practical activities. I would also like to express my strong conviction that we meet each other in occasion of the 16th year of this conference held in 2019.

I wish you pleasant reading!

Petr Valouch

Chairman of the Program Committee

CONTENTS

Mária Barteková, Ľudomír Šlahor

THE FINANCIAL ANALYSIS OF THE EDUCATION SUPPORT FUND: RECENT RESULTS FROM SLOVAKIA..... 16

Karina Benetti

LIFE INSURANCE IN THE CZECH REPUBLIC: NEW CHALLENGES? 24

Karina Benetti

CORPORATE BANKRUPTCIES IN THE CZECH REPUBLIC: THE DEVELOPMENT OVER THE LAST DECADE 32

Kamila Bielawska

RETIREMENT DECISIONS OF SENIORS IN POLAND IN THE LIGHT OF THE QUALITATIVE RESEARCH..... 39

Martina Borovcová, Adéla Špačková

DETERMINATION AND VERIFICATION OF THE KEY ASSESSMENT INDICATORS FOR THE INSURANCE MARKET BY APPLYING THE DECOMPOSITION MULTI-ATTRIBUTE METHODS AND REGRESSION ANALYSIS..... 44

Rafał Buła

FRACTAL DIMENSION VS. NON-FRACTAL RISK MEASURES – CORRELATION ANALYSIS 53

Małgorzata Cygańska, Magdalena Kludacz-Alessandri, Dimitrios Syrrakos

MEASURING EFFICIENCY IN CLINICAL DEPARTMENTS USING THE DEA APPROACH - A CASE OF THE POLISH HOSPITAL 61

Darya Dancaková

THE IMPACT OF EDUCATIONAL EXPENDITURES AND HIGHER EDUCATION ATTAINMENT ON EMPLOYMENT IN V4 COUNTRIES..... 70

Karolina Daszyńska-Żygadło, Jakub Marszałek, Krzysztof Piontek

SUSTAINABLE FINANCE INSTRUMENTS' RISK - GREEN BOND MARKET ANALYSIS 78

Bohuslava Doláková

DEBT LITERACY AND ITS IMPORTANCE IN THE CZECH REPUBLIC 86

Małgorzata Doman, Ryszard Doman

PATTERNS OF CURRENCY CO-MOVEMENT: CHANGES IN THE IMPACT OF GLOBAL CURRENCIES..... 94

Michal Fabuš, Viktória Čejková

MOTOR VEHICLE INSURANCE IN SMES 102

Maria Forlicz, Tomasz Rólczyński

RATIO BIAS UNDER CONDITIONS OF UNCERTAINTY – EXPERIMENTAL RESULTS..... 109

Ján Gogola, Lucie Kopecká	
ACTUARIAL MODEL FOR PRICING DISABILITY INSURANCE POLICY.....	116
Ewa Gubernat	
EFFECTIVENCES OF COMMERCIAL BANKS IN POLAND VERSUS BANK TAX.....	123
Peter Haiss, Jakob Schmid-Schmidsfelden	
BITCOIN COMPARED ON PRICE, LIQUIDITY AND VOLATILITY: CRYPTO "CURRENCIES" OR AN ASSET CLASS OF THEIR OWN?	128
Filip Hampl	
SPECIFICS OF THE REPORTING UNDER INTERNATIONAL ACCOUNTING STANDARD IAS 41 AGRICULTURE AND ITS USAGE ON THE CENTRAL EUROPEAN STOCK EXCHANGES.....	139
Haochen Guo	
VOLATILITY MODEL BASED GARCH MINIMUM VARIANCE HEDGING	147
Taťána Hajdíková, Kateřina Trubačová	
EFFICIENCY HOSPITALS IN THE CZECH REPUBLIC: THE DIFFERENCE BETWEEN THE METHODS USED	154
Martina Hedvičáková, Martin Král	
LEVEL OF INDUSTRY AUTOMATION 4.0 IN THE CZECH REPUBLIC AND IMPACT ON UNEMPLOYMENT	160
Irena Honková	
INDUSTRY 4.0 AIMED AT ACCOUNTING SYSTEM.....	168
Jan Horvat, Eva Horvatova	
CAPITAL CREATION FACTORS IN SELECTED BANKING SECTORS OF EUROPE	174
Eva Horvatova	
EFFICIENCY OF BANKS IN SLOVAK REPUBLIC	180
Agnieszka Huterska, Robert Huterski, Justyna Łapińska	
IMPACT OF MACROECONOMIC FACTORS ON THE VALUE OF LOANS GRANTED TO NON-FINANCIAL ENTERPRISES BY MONETARY FINANCIAL INSTITUTIONS IN THE EURO AREA COUNTRIES.....	189
Jana Hvozdenka	
CONVERGENCE OF THE GOVERNMENT BOND YIELDS IN ESTONIA, LATVIA AND LITHUANIA	196
Lenka Janošová, Petr Mikuš	
A RELATIONSHIP BETWEEN GENDER AND AGE DIVERSITY AMONG BOARD MEMBERS AND FIRM PERFORMANCE	202
Monika Kaczała	
THE INFLUENCE OF GOVERNMENT SUPPORT ON THE CROP INSURANCE UPTAKE	210

Marcin Kalinowski, Grzegorz Krzykowski

STRUCTURAL EVALUATION OF SECURITIES' RATES OF RETURN IN SELECTED BUSINESS SECTORS ON NEW YORK STOCK EXCHANGE..... 219

František Kalouda

STABILITY PREREQUISITES OF THE CZECH REPUBLIC BANKING SYSTEM (CYBERNETIC POINT OF VIEW) 227

Özcan Karahan

HOW THE CHANGES IN EXCHANGE RATE AFFECT THE TURKISH ECONOMIC GROWTH UNDER INFLATION TARGETING REGIME? 235

Özcan Karahan, Metehan Yılgör, Hakan Öndes

THE EFFECT OF BANK CREDIT ON THE CURRENT ACCOUNT BALANCE IN TURKEY 243

Marcin Kędzior, Dorota Kędzior

RELATIONS BETWEEN IFRS ADOPTION AND FINANCIAL AND NON-FINANCIAL MEASURES OF ECONOMIC ENTITIES, EMPIRICAL RESULTS FROM THE SELECTED COUNTRIES OF WESTERN EUROPE 251

Natália Klempaiová, Mária Bohdalová

COMPARISON OF GULKA'S MODEL AND MODEL IN05 ON SAMPLE OF SLOVAK INDUSTRIAL COMPANIES 259

Kristína Kočišová, Jakub Sopko

THE EFFICIENCY OF HEALTH SYSTEMS IN OECD COUNTRIES WITH NOVEL DEA METHODOLOGY 267

Katarzyna Kochaniak

HOUSEHOLD DEPOSITS' AVAILABILITY FOR CREDIT INSTITUTIONS DURING TENSIONS ON FUNDING MARKETS – A CASE OF THE EURO AREA COUNTRIES 276

Anna Magdalena Korzeniowska

MOTIVES OF HOUSEHOLDS FOR SAVING IN POLAND 284

Anna Magdalena Korzeniowska, Wojciech Misterek

THE RELATIONSHIP BETWEEN SAVING AND DEBT IN POLISH HOUSEHOLDS 292

Jaroslav Kovárník, Eva Hamplová

THE SELECTED ASPECTS OF FOREIGN TRADE IN CENTRAL EUROPEAN COUNTRIES 299

Anna Krajewska, Magdalena Kapela

LABOUR TAXATION IN THE EUROPEAN UNION. COMPARATIVE ANALYSIS AND CONCLUSIONS FOR POLAND 307

Anna Krajewska, Katarzyna Osiecka

TAXATION OF CONSUMPTION IN POLAND. REDISTRIBUTION AND FISCAL EFFECTS..... 315

Jan Krajíček

PROBLEMS IN THE BANKING SECTOR..... 323

Peter Krištofík, Michaela Novotná

**THE IMPACT OF BEHAVIORAL FINANCE ON THE FINANCIAL PERFORMANCE
OF AN ENTERPRISE 328**

Zuzana Kubaščíková, Miloš Tumpach, Zuzana Juhászová

USING OF NON-FINANCIAL DATA IN PREDICTIVE MODELS 334

Michal Kuběnka, Renáta Myšková, Josef Novotný, Vít Jedlička

**THE ROLE OF APPARENT SIGNS OF FINANCIAL DISTRESS IN TEST SAMPLES
AND VERIFICATION SAMPLES OF BANKRUPT MODELS 341**

Jana Kubicová

**THE ANTI-TAX-AVOIDANCE MEASURES IN THE EU – FROM DENIALS TO WIDE
ACCEPTANCE 348**

Gabriela Kukalová, Lukáš Moravec, Jakub Ječmínek, Barbora Martášková

FINANCIAL CRISIS INFLUENCE ON TAX MIX CHANGES 355

Malwina Lemkowska

ENVIRONMENTAL RISK INSURABILITY ISSUES – THE EU PERSPECTIVE 364

Karolina Lisztwanová, Iveta Ratmanová

**ASSESSMENT OF FACTORS INFLUENCING OF FINAL CORPORATE INCOME TAX
LIABILITIES IN SELECTED SECTORS IN THE CZECH REPUBLIC..... 372**

Ondřej Machek, Aleš Kubíček

**FINANCIAL PERFORMANCE OF CZECH PRIVATELY-HELD FIRMS WITH MULTIPLE
OWNERS 380**

Marina Malkina

**SPATIAL INEQUALITY IN OWNERSHIP AND ACTIVITY OF BANKING SECTOR: CASE
OF RUSSIA..... 387**

**Tomáš Meluzín, Marcin Faldziński, Michał Bernard Pietrzak, Adam P. Balcerzak,
Marek Zinecker**

**THE USE OF BACKTESTING IN ASSESSMENT OF THE VALUE-AT-RISK ON UNITES
STATES, GREAT BRITAIN AND GERMAN CAPITAL MARKETS..... 395**

Michal Mešťan, Maroš Malíček, Matej Žofaj, Ivan Králik

CHANGES IN CONSUMER CREDIT MARKET IN SLOVAKIA 402

Grzegorz Michalski

**THE RELATIONSHIP BETWEEN DEBT AND EQUITY IN SOCIAL ECONOMY
ORGANIZATIONS – POLISH CASE 410**

Katarzyna M. Miszczyńska

**DETERMINANTS OF PUBLIC HEALTHCARE UNITS INDEBTEDNESS – THE CASE
OF PUBLIC HOSPITALS IN LODZ 420**

Piotr Miszczyński

**PROFITABILITY FORECAST FOR ASSESSMENT OF INVESTMENT PROJECT
IN BANKING 427**

Lukáš Moravec, Jana Hinke, Gabriela Kukalová, Zuzana Tichá

EFFECTS OF FINANCIAL ACCOUNTING HARMONIZATION ON AGRIBUSINESS 436

László Nagy, Mihály Ormos

FINANCIAL MARKET IMPLIED INDUSTRY CLASSIFICATION 445

Danuse Nerudova, Veronika Solilova, Marian Dobranschi, Marek Litzman

**THE ROLE OF CORPORATE INCOME TAX DIFFERENCES ON THE PROFIT SHIFTING
BEHAVIOR: EVIDENCE FROM THE CZECH REPUBLIC 454**

Aleksandra Nocon

MONETARY POLICY NORMALIZATION OF THE EUROPEAN CENTRAL BANK 462

Tomáš Ondruška, Zuzana Brokešová, Erika Pastoráková

DETERMINANTS OF NON-LIFE INSURANCE CONSUMPTION 470

Denisa Oriskóová, Renáta Pakšiová

DECOMPOSITION OF ROE TO SELECTED FINANCIAL ANALYSIS INDICATORS. 479

Gabriela Oškrdalová

**INTERNET SHOPPING IN THE CZECH REPUBLIC WITH THE FOCUS ON THE TYPES
OF BOUGHT GOODS AND SERVICES BY CONSUMERS 487**

Dalibor Pánek

**THE TERMINATION OF FOREIGN EXCHANGE INTERVENTIONS AND THE BALANCE
SHEET OF THE CENTRAL BANK..... 495**

**Sergey Petrov, Nadezhda Yashina, Oksana Kashina, Nataliya Pronchatova-
Rubtsova**

**INVESTORS' EXPECTATIONS, PRICE-DIVIDEND DEPENDENCE AND P/E RATIO
FOR COMMON STOCK: SPECIFICS OF WELL-DEVELOPED MARKETS AND EMERGING
MARKETS 500**

Aleksandra Pieloch-Babiarz

**LONG-TERM STOCK RETURNS OF COMPANIES IMPLEMENTING DIVERSE
DIVIDEND POLICY: EVIDENCE FROM POLAND 509**

Sylwia Pieńkowska-Kamieniecka

**THE ISSUE OF RESPONSIBILITY FOR FINANCIAL SECURITY IN OLD AGE AND
ADDITIONAL RETIREMENT SAVING 518**

Anatoliy Pilyavskyy, Lucie Kopecká

**THE EFFICIENCY OF HEALTH CARE SYSTEMS IN OECD COUNTRIES. DOES IT MAKE
A DIFFERENCE? 525**

Sylvia Plottová

**GOING PUBLIC IN SELECTED CEE CAPITAL MARKETS: EMPIRICAL EVIDENCE
ON IPO VOLUMES AND DRIVERS 531**

Sylvia Plottová

CAPITAL MARKET DETERMINANTS OF GOING PUBLIC: THE EVIDENCE FROM CEE CAPITAL MARKETS..... 536

Veronika Popelková

NON-FINANCIAL INFORMATION ACCORDING TO THE ACT ON ACCOUNTING IN THE CZECH REPUBLIC 543

Lenka Přečková, Eva Vávrová

EVALUATION OF EXPENSE RATIO OF INSURANCE PORTFOLIOS BELONGING TO SELECTED INSURANCE COMPANIES OPERATING ON CZECH INSURANCE MARKET 550

Barbora Ptáčková, Dagmar Richtarová

COMPARISON OF ANALYSIS DEVIATION METHODS FOR THE MULTIPLICATIVE OPERATIONS 559

Zuzana Rakovská

BELIEFS IN CRYPTOCURRENCY: EXPLORING THE RELATIONSHIP BETWEEN SENTIMENT AND BITCOIN 567

Oldřich Rejnuš

THE CURRENT PROBLEMS OF THE EUROZONE AND THE FUTURE TRANSFORMATION OF THE EUROPEAN UNION 575

Jerzy Róžański

COMPARATIVE ANALYSIS OF FINANCING SOURCES IN DOMESTIC AND FOREIGN ENTERPRISES IN POLAND 583

Pavla Říhová, Milan Svoboda

PROFITABILITY OF SELECTED TECHNICAL ANALYSIS INDICATORS 591

Jaroslav Sedláček, Filip Hampl, Elena Láncošová

THE INFLUENCE OF ACCOUNTING FOR GOODWILL ON THE BOTTOM LINE OF BUSINESS CORPORATIONS 599

Pavel Sedláček, Miroslav Svoboda

GENERAL DATA PROTECTION REGULATION IN THE CONTEXT OF MUNICIPALITIES..... 608

Ilja Schaab, Eric Frère, Alexander Zureck

SYNDICATED LOAN MARKET GERMANY: DEEP DIVE INTO ROLE ALLOCATION 613

Eugenia Schmitt

BACKTESTING EXPECTED SHORTFALL – IS THERE A METHOD SUITABLE FOR MIDDLE-SIZED BANKS? 621

Martin Sirucek, Jan Vystoupil, Petr Strejček

PROFITABILITY OF SECTOR MUTUAL FUNDS AND ETFS DURING MARKET DEVELOPMENT..... 629

Roman Skalický

LEGAL BACKGROUND FOR A DIFFERENT EXPERT ASSESSMENTS OF A BUSINESS ENTERPRISE BELONGING TO A COMMERCIAL COMPANY AND OF A BUSINESS SHARE IN A COMMERCIAL COMPANY..... 639

Błażej Socha, Dariusz Urban

THE FINANCIALIZATION AND OPERATING PERFORMANCE OF NON-FINANCIAL COMPANIES LISTED ON THE WARSAW STOCK EXCHANGE 646

Tomasz Sosnowski, Anna Wawryszuk-Misztal

THE EFFECT OF THE ACCOUNTING HOCUS-POCUS ON THE MANAGEMENT EARNINGS FORECAST PRECISION IN THE IPO 653

Ivan Soukal, Eva Hamplová

PRELIMINARY RESULTS OF NON-BANK CONSUMER CREDIT PROVIDERS IN THE PROFESSIONAL QUALIFICATIONS TEST BY THE ACT NO. 257/2016 COLL., ON CONSUMER CREDIT 662

Martina Sponerová, Miroslav Svoboda, Miroslav Sponer

THE ROLE OF NONFINANCIAL INDICATORS IN THE PROCESS OF CREDIT RISK ASSESSMENT 670

Anna Sroczyńska-Baron

THE RECENT HISTORY OF E-COMMERCE IN POLAND AND THE PERSPECTIVES FOR ONLINE SALE GROWTH IN FUTURE..... 681

Jelena Z. Stanković, Evica Petrović, Ksenija Denčić-Mihajlov

THE FINANCIAL AND INSTITUTIONAL ENVIRONMENT FOR SUSTAINABLE ECONOMIC GROWTH OF DEVELOPING COUNTRIES: THE CASE OF WESTERN BALKAN 689

Dirk Stein, Alexander Zureck, Tina Jäger

A CALL TO THEORIZE DIGITAL INFORMATION TECHNOLOGY DUE DILIGENCE: ANALYSIS OF RESEARCH GAPS FOR THE SUBJECT OF INFORMATION TECHNOLOGY DUE DILIGENCE IN MERGERS AND ACQUISITIONS 697

Erik Suchý, Michal Šoltés

INFLUENCE OF CAPITAL MARKET ON THE US UNEMPLOYMENT AND GDP 708

Veronika Svatošová, Sylva Chalupová, Petra Dvořáková

IDENTIFICATION OF FINANCIAL STRATEGY IN E-COMMERCE 715

Martin Svítal

QUALITATIVE INDICATORS (SOFT-FACTS) IN INTERNAL RATING SYSTEMS .. 725

Martin Svoboda, Svend Reuse, Annika Rüder, Noel Boka

INTEREST RATE RISK IN THE BANKING BOOK (IRRBB) – COMPARING VARIANCE/COVARIANCE WITH HISTORICAL SIMULATION AND SEVERAL COPULA FUNCTIONS WITH FOCUS ON THE ACTUAL EBA GUIDELINES 733

Miroslav Svoboda, Tomáš Plíhal, Pavel Sedláček

RANDOM STRATEGY VERSUS TECHNICAL ANALYSIS STRATEGY: THE CASE OF GBP/USD INTRADAY TRADING..... 743

Libuše Svobodová, Jaroslava Dittrichová	
BUSINESS ENTITIES AND LOANS IN THE CZECH REPUBLIC.....	749
Łukasz Szewczyk	
RECENT CHANGES IN THE POLISH DEPOSIT GUARANTEE SCHEME	757
Rafał Szmajser, Mariusz Andrzejewski, Marcin Kędzior	
PROFITABILITY DETERMINANTS OF POLISH OUTSOURCING SERVICE ENTERPRISES FROM THE POINT OF VIEW OF TOP AND MIDDLE MANAGEMENT.....	764
Elena Širá, Dana Kisel'áková, Beáta Šofranková	
COMPETITIVENESS OF V4 COUNTRIES IN THE FIELD OF HIGHER EDUCATION	773
Yuan Tian	
COPULAS AND CREDIT RISK MODELS	780
Petr Valouch, Josef Nesleha	
IMPACT OF MERGERS ON THE COMPANY PERFORMANCE.....	788
Eva Vávrová, Lenka Přečková	
TECHNICAL PROVISIONS AS ONE OF THE RISK MANAGEMENT MODES OF COMMERCIAL INSURANCE COMPANIES OPERATING ON THE CZECH INSURANCE MARKET	794
Jana Vodáková, Nela Sglundová	
ACTIVITIES CLASSIFICATION FOR CONTROLLING PURPOSES IN THE STATE ADMINISTRATION UNIT	803
Lukáš Vodička	
BANKING SYSTEM DEVELOPMENT AND ECONOMIC GROWTH: EVIDENCE FROM A SAMPLE OF HIGH INCOME COUNTRIES AND LOW & MIDDLE INCOME COUNTRIES	810
Damian Walczak	
EQUALITY IN OLD-AGE SECURITY IN POLAND.....	818
Radosław Witczak	
THE USE OF DIFFERENT METHODS OF THE TAX BASE ESTIMATION IN INCOME TAXES IN THE LIGHT OF SAC RULINGS IN 2017 IN POLAND	825
Elżbieta Wrońska-Bukalska	
DEBT CAPACITY AND CAPITAL STRUCTURE OF THE COMPANIES MANAGED BY OVERCONFIDENT CEO	831
Joanna WYROBEK	
APPLICATION OF SELECTED MACHINE LEARNING METHODS TO COMPANIES' INSOLVENCY PREDICTION	839

Sergey Yashin, Nadezhda Yashina, Nataliya Pronchatova-Rubtsova, Oksana Kashina

METHODICAL APPROACHES TO ASSESSING THE BUDGET POTENTIAL OF THE REGION TAKING INTO ACCOUNT THE INNOVATIVE DEVELOPMENT OF HIGH-TECH INDUSTRIES 849

Nadezhda Yashina, Nataliya Pronchatova-Rubtsova, Sergey Petrov, Oksana Kashina

METHODICAL APPROACHES TO THE FORMATION OF MODEL BUDGETS IN ORDER TO IMPROVE THE EFFECTIVENESS OF THE BUDGET PROCESS IN RUSSIA..... 857

The Financial Analysis of the Education Support Fund: Recent Results from Slovakia

Mária Barteková¹, Ľudomír Šlahor²

¹ Comenius University in Bratislava
Faculty of Management, Department of Economics and Finance
Odbojárov 10, 820 05 Bratislava, Slovakia
E-mail: maria.bartekova@fm.uniba.sk

² Comenius University in Bratislava
Faculty of Management, Department of Economics and Finance
Odbojárov 10, 820 05 Bratislava, Slovakia
E-mail: ludomir.slabor@fm.uniba.sk

Abstract: *The analysis of institutions providing financial services has always been particularly challenging because of the manner how the financial institutions operate and generate profit. The purpose of this study is to analyse the financial performance of the Education Support Fund – the institution providing state subsidised student loans in Slovakia. Tertiary students are eligible for the loan application from the Education Support Fund. All European countries realize that tertiary education is one of the driving forces of economic growth. The empirical part of the paper consists of the financial statement analysis focused on the performing ratios. Ratio analysis is one of the most widely used fundamental analysis technique. The most significant opportunity that emerged from our analysis is to reach the positive net profit as the evidence of financial sustainability and stability. We have identified the net interest margin, the loan-to-assets ratio, and the return-on-assets (ROA) ratio as the most reliable ratios for the financial performance comparison. In recent years, the slightly increasing values of the performing ratios have shown the financial stability of the Education Support Fund.*

Keywords: *student loans, financial ratios, Education Support Fund*

JEL codes: *G23, G29, G32*

1 Introduction

Education has long been seen as a crucial tool for national development, with various education initiatives designed to work towards eliminating poverty, increasing the health of a population or enhancing local economies, among others. Strengthening the social dimension of higher education is still a key political goal on the European level. To expand the knowledge base and foster progress, an increasing number of European citizens require high level knowledge and competences. One of the key challenges in developing quality mass higher education systems is to ensure that students have the necessary material conditions to study and fulfil their potential. The question of how this is ensured at national level is a key aspect of the social dimension of higher education, and student fee and support systems are thus important tools of national policies.

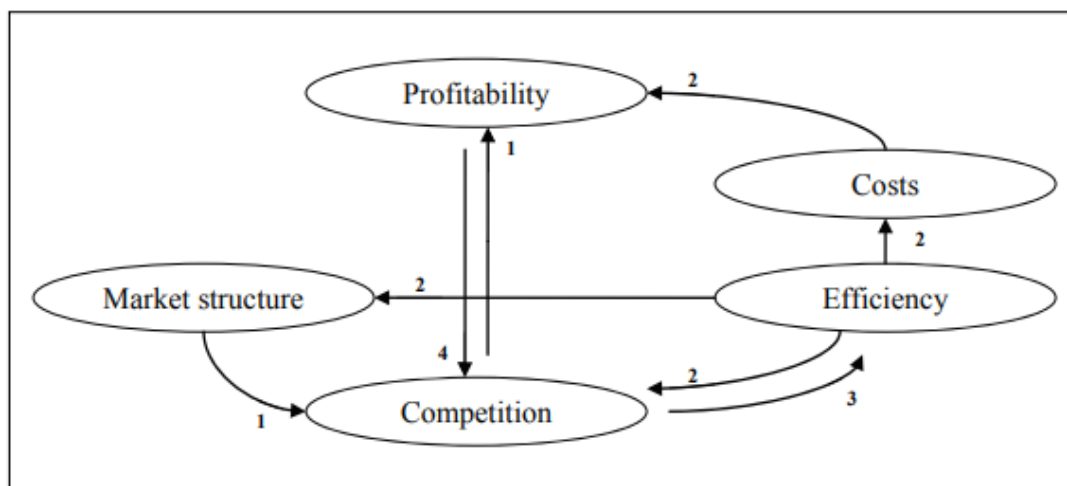
To assess the Education Support Fund's financial performance we use the financial analyses indicators. Various performance aspects cannot be observed directly whereas they are economically important. While stockholders will view performance in terms of the profits made on their behalf, whether or not adjusted for risks taken, this article focuses on performance in a broader sense, that is, the contribution financial institutions make to the common wealth, on behalf of consumers and businesses. They will be mainly interested in whether financial products are not too expensive and whether the quality is sufficient. This raises the issue of, on the one hand, the efficiency of financial institutions (i.e. whether unnecessary costs are made in bringing a product to market) and, on the other, the level of competition in the relevant markets (i.e. whether profit margins are not unnecessarily high).

Adequate performance of financial institutions is of crucial importance to their customers. Prices and quality of their products are determined by efficiency and competition. Since efficiency and competition cannot be observed directly, various indirect measures in the form of simple indicators or complex models have been devised and used both in theory and in practice (Bohdalová and Greguš, 2017).

As the main role of the Education Support Fund is the student loan providing, we compare the Fund's performance with the results reached by the banking sector in Slovakia. The banking sector's aggregate profit generated in Slovakia has come under severe pressure from falling interest margins. Although the sector's profit increased in 2016 by 19.8%, year on year, that growth was driven by several one-off and exceptional factors. Excluding their impact, the overall profit dropped by 11%. The sector's total capital ratio increased slightly, to 18% (The National Bank of Slovakia, 2016).

Relation 1 describes the influence of competition to profitability of the financial institution and market structure to competition at the market (see Figure 1). Competition also affects financial innovations, Fund's financial health, financial stability and the accessibility of the Fund's services to clients (Bikker, 2010). More efficient financial institutions will translate lower costs into either increased profits or price reductions – the latter in order to improve their competitiveness and increase their market share (indicated by a relation '2' in Figure 1). Efficiency thus is not an effect but a determinant of market structure. It has been generally assumed that competitive pressure forces financial institutions to become more efficient (indicated by a relation '3'). Excess profits enable financial institutions to lower their prices and become more competitive in order to increase their market share (indicated by a relation '4').

Figure 1 Relations Between Profitability, Efficiency and External Environment



Source: Bikker, J. A.

Section 2 describes the Education Support Fund as the unique Slovak student loan provider. Section 3 discusses methodology used in this paper and the main sources of data. The financial analysis focused on the various performance ratios is a part of section 4. Section 5 concludes.

2 The Education Support Fund

The Education Support Fund was established on 1 January 2013 by Act No. 396/2012 Coll. on the Education Support Fund as the legal successor of the Student Loan Fund and Loan Fund for Starting Educators. The main activity of the Education Support Fund is to provide loans to university students, teaching staff, professional school employee and doctoral study programme students in the full-form of studies (Education Support Fund, 2017).

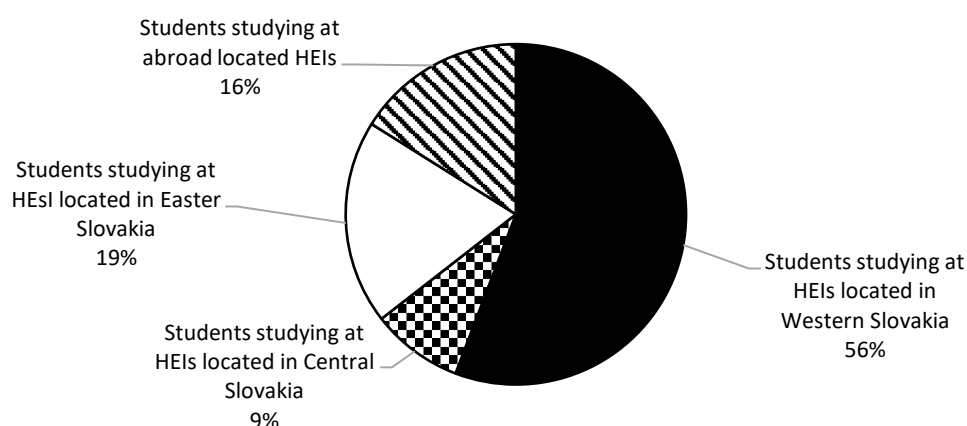
The applicant must also meet the following requirements:

- Have a permanent residence in the territory of the Slovak Republic; or
- Have the status of a Slovak living abroad; or
- Be a citizen of the European Union with the right to permanent residence in the territory of the Slovak Republic or a family member of such person with the right to permanent residence.

Loans represent the primary earning asset at the Education Support Fund. Loans provided by the Education Support Fund are dedicated for the students studying at the higher education institutions (HEIs) and are purposeless (Education Support Fund, 2018).

Figure 2 shows distribution of the approved student loans in the academic year 2017/2018. As one can see, more than 55 % of the supported students are studying at HEIs located in Western Slovakia. Just around 16 % of all supported students are studying abroad.

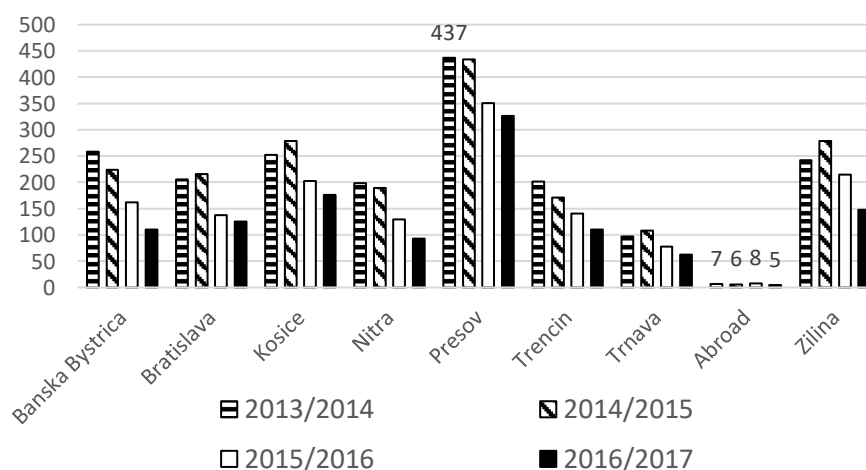
Figure 2 Approved Student Loans Distribution in the Academic Year 2017/2018



Source: The Education Support Fund, own calculations

Reducing disparities will require increasing the labor utilization ratio and improving the structural and policy determinants of productivity in the eastern regions of Slovakia (Fadoš and Bohdalová, 2017). Toll for the increasing labor utilization ratio is also the social support for tertiary students. In the long term, the biggest group of the supported students are coming from the following regions: Presov (eastern Slovakia), Kosice (eastern Slovakia) and Zilina (northern Slovakia). The smallest group in the number of approved loans are students coming from abroad (Figure 3).

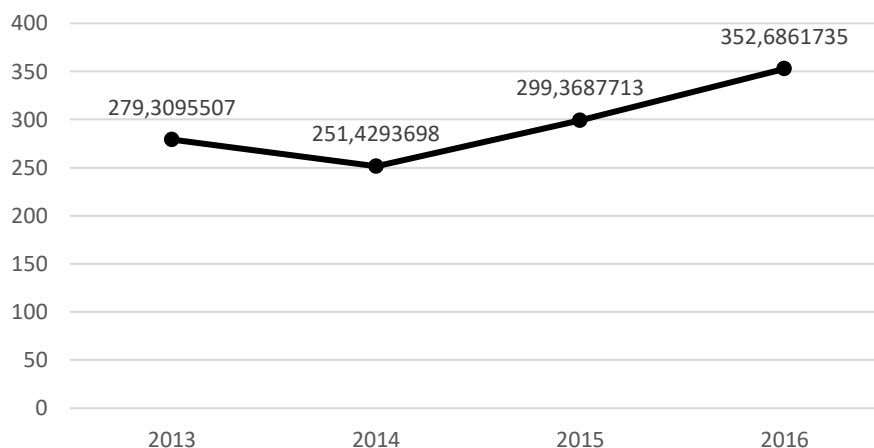
Figure 3 Amount of Supported Students in the Academic Year 2013/2014 – 2016/2017 by the Place of Residence



Source: The Education Support Fund, own calculations

Total costs per student loan include all expenses related to providing the loan and paid from the budget of the Education Support Fund divided by the number of approved student loans. The decreasing number of provided loans caused increase of the total costs per student loan reported in 2016 (Figure 4).

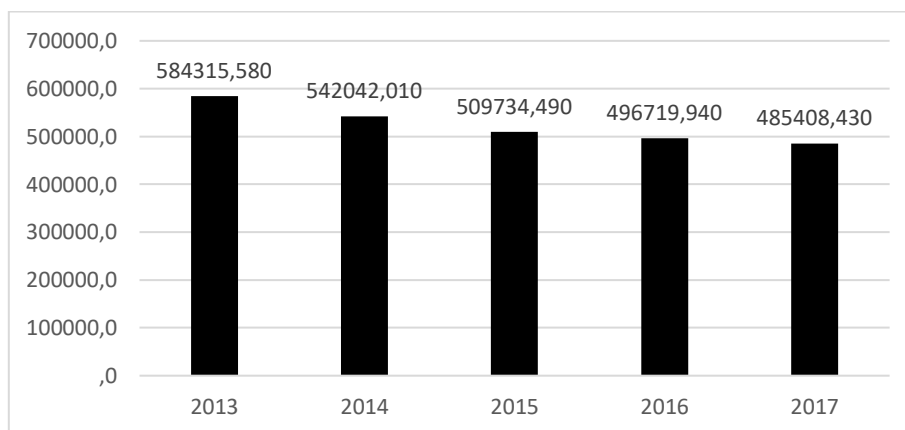
Figure 4 Total Costs per Provided Student Loan (2013 - 2016)



Source: The Education Support Fund, own calculations

The operational efficiency is the capability of an institution to deliver services to its customers in the most cost-effective manner possible while still ensuring the high quality of its services. Figure 5 shows development of the operational expenditures from the Fund's establishment to 2017. Amount of the operational expenditures decreases every year and the total value is under the legal limit. The operational expenses may not exceed 3.5% of the outstanding principal of loans per year as of 31 December the previous year (Act No. 396 of 2012 Coll. on the Education Support Fund). The operational efficiency still increases.

Figure 5 Development of the Operational Expenses from 2013 to 2017



Source: Education Support Fund, own calculations

Efficiency based on the transformation of costs into benefits as measured. Efficiency is a measure of how economically resources/inputs (funds, expertise, time, etc.) are converted to results. These ratios enable the management to measure the effectiveness or usages of the resources at the command of institution.

3 Methodology and Data

Since the purpose of this research is to gain a better insight into the determining and presenting the relationship of items or group of items in the financial statement of the Education Support Fund.

We have identified the net interest margin (NIM), the return-on-assets (ROA) ratio, the return-on-equity (ROE) ratio, Equity multiplier (EM), Burden/Total Assets ratio, Current ratio and Quick ratio as the most reliable ratios for the financial performance analysis.

EM indicator presents the ratio between the financial assets of the banking sector and their equity (Matuszaka and Rozanska, 2017). This can be used alongside other measurements of the financial leverage of this sector to ascertain its overall financial stability and to analyse its financial health.

Return on equity (ROE) analysis provides a system for planning as well as analyzing financial institution performance. The profit margin allows the analyst to develop a pro forma income statement (Gavurova et al., 2017). That is, net income is equal to revenues less expenses. Thus, the financial planner can determine the revenue level necessary to achieve the net income target. The total asset turnover ratio allows the analyst to project the total asset level necessary to generate the projected revenue level. The total asset requirement can be used to project the pro forma levels of all of the asset accounts (Chorvatovičová and Saxunová, 2016). The fundamental equation of accounting is that assets equal liabilities plus owners equity. Thus, the equity multiplier ratio can be used to project the pro forma financial needs and the financial structure of the financial institution.

We draw on data from:

- Database of The National Bank of Slovakia,
- OECD database,
- The Education Support Fund's database to track how the performance indicators evolved between 2016 and 2017.

The financial reports of the Education Support Fund are the main sources of data in this paper.

4 Results and Discussion

This session introduces fund financial statements and provides a traditional, ratio-based procedure for analyzing fund financial performance using historical data. It demonstrates the interrelationship between the income statement and balance sheet and describes the risk and return trade-off underlying management decisions.

Table 1 Balance Sheet in EUR - Year 2016 and 2017

	2016	2017
A. Invested Assets	33 957 079	32 857 561
B. Current Assets	4 175 857	5 489 992
C. Prepayments and Accrued Income	1 029	1 318
Total Assets	38 133 965	38 348 871
D. Equity	38 071 437	38 287 084
E. Provisions	0	0
F. Liabilities	62 528	61 787
G. Accrued Expenses and Deferred Income	0	0
Total Liabilities	38 133 965	38 348 871

Source: The Education Support Fund

Investment decisions affect the left-hand side of the balance sheet through asset purchases (Del Giudice et al., 2016). Investment decisions determine the type of assets used by the Education Support Fund, the industry in which the fund operates, and the degree of operating leverage of the fund. Financing decisions affect the right-hand side of the balance sheet, which shows the financial structure of the fund through security issues and retained earnings. Financing decisions determine the capital structure of the fund and the degree of financial leverage.

The Education Support Fund's income statement reflects the fact that most assets and liabilities are financial (Table 2). Revenue consists primarily of interest income and interest payments on liabilities represent the primary expense. The statement format starts with

service revenues then subtracts operational expense. The next step is to subtract provision for loan losses, which represents management's recognition that some revenues will be lost due to bad loans. The format continues by adding interest income then subtracting interest expense and taxes to produce net income.

Table 2 Income Statement in EUR - Year 2016 and 2017

	2016	2017
Service Revenues	136 373	134 219
Operational Expenses	560 557	550 801
Other Revenues	58 299	113 295
Other Expenses	20 817	19 745
Trading Loss	- 386 702	- 323 032
Interest Income	937 813	896 146
Interest Expenses	382 150	347 640
Financial Profit	555 663	548 506
Profit on Ordinary Business Profit	168 961	225 474
Profit/Loss on Extra Ordinary Events	0	0
Net Profit before Tax	168 961	225 474
Tax Liability	1 670	1 441
After Tax Profit	167 709	224 033
Net Profit per Balance Sheet	167 709	224 033

Source: The Education Support Fund

The following analysis uses data from Table 1 and Table 2 to calculate and interpret the various profitability ratios. The profitability ratio formulas are:

$$ROE = \frac{\text{Net Income}}{\text{Total Equity Capital}} \quad (1)$$

$$ROA = \frac{\text{Net Income}}{\text{Total Assets}} \quad (2)$$

$$EM = \frac{\text{Total Assets}}{\text{Total Equity Capital}} \quad (3)$$

$$NIM = \frac{\text{Net interest income}}{\text{Earning Assets}} \quad (4)$$

The liquidity ratio formulas used in this paper are following:

$$\text{Current ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}} \quad (5)$$

$$\text{Quick ratio} = \frac{\text{Cash equivalents} + \text{Marketable securities} + \text{Accounts receivables}}{\text{Current Liabilities}} \quad (6)$$

Return on equity (1) equals net income divided by stockholders' equity and thus measures the percentage return on stockholders' investment (Ray and Mitra, 2018). The higher the return the better, as management can pay higher dividends and support greater future growth. Return on equity reached in 2017 just 0.59 %.

ROE is tied to ROA (2) through a fund's equity multiplier (EM), which equals total assets divided by stockholders' equity. EM (3) measures a fund's financial leverage, or its amount of liabilities compared with equity. The greater are aggregate liabilities, the greater is financial leverage and EM (OECD, 2018).

Net interest margin (4) equals net interest income divided by earning assets and thus represents the net interest return on income producing assets. The results of the profitability analysis are shown in Table 3. Almost every profitability ratio of the Education Support Fund was miserable low and very far from set targets. In year-to-year comparison, profitability ratios as ROE, ROA, NIM and Burden/Total Assets attained better values.

Table 3 Profitability Indicators in 2016 and 2017 and Profit Targets

	2016	2017	Target
ROE	0.51%	0.59%	>18.00%
ROA	0.51%	0.58%	>1.25%
EM	1.00	1.00	>12.5X
NIM	1.70%	1.80%	>4.50%
Burden/Total Assets	1.00 %	0.90%	< 2.00%

Source: Own calculations, Bikker, J.A., The Education Support Fund

As one can see, Burden/ Total Assets ratio reached in both years is better than the recommended target (Table 3).

The current ratio (5) measures the ability of a company to cover its short-term liabilities with its current assets. Table 4 contains the financial results focused on the current liquidity position and the liquidity targets. A quick ratio is ineffectively greater than industry average. The current liquidity position of the Education Support Fund is really good and sustainable. The reached values in both cases are influenced by the operating cycle of the student loans provisioning.

Table 4 Liquidity Indicators in 2017 and Liquidity Targets

	2017	Target
Current ratio	132,22	>1.00
Quick ratio	130,51	>1.20

Source: The Education Support Fund, own calculations

The quick ratio (6) is more conservative than the current ratio because it excludes inventory and other current assets, which generally are more difficult to turn into cash. A higher quick ratio means more liquid current position (The National Bank of Slovakia, 2017).

5 Conclusions

It has been established that with the help of a combination of appropriate indicators – we could make a good deal of headway towards a better understanding of the Education Support Fund's financial performance. Aggregate profitability among financial institutions measured by ROE and ROA has varied very slightly from year to year.

The main purpose of the Education Support Fund is to provide student loans with the favorable interest rate. However, profitability is the primary goal of all businesses. Without profitability the business will not survive in the long run. So measuring current and past profitability and projecting future profitability is very important. The most of profitability ratios showed that the Education Support Fund is not profitable and confirmed the social dimension of the student loans provisioning in Slovakia.

The current liquidity position of the Education Support Fund is very favorable in comparison to set targets. Generally, companies would aim to maintain a current ratio of at least 1 to ensure that the value of their current assets cover at least the amount of their short term obligations. The value of the current and quick ratio reached in 2017 more than 130.

References

Act no. 396/2012 Coll., on the Education Support Fund.

Bikker, J. A. (2010). Measuring Performance of Banks: An Assessment. *Journal of Applied Business and Economics*, vol. 11(4), pp. 141-159.

Bohdalová, M., Greguš, M. (2017). Impact of uncertainty on European market indices quantile regression approach. In: *CBU International Conference on Innovations in Science and Education*. Praha: Central Bohemia University, pp. 57-61.

Del Giudice, M., Campanella, F., Dezi, L. (2016). The bank of things: An empirical investigation on the profitability of the financial services of the future. *Business Process Management Journal*, vol. 22(2), pp. 324 - 340.

Education Support Fund (2018). *Annual report 2017*. Retrieved from: <http://www.fnpv.sk/vyrocná-správa-2017>.

Education Support Fund (2017). *Annual report 2016*. Retrieved from: <http://www.fnpv.sk/vyrocná-správa-2016>.

Fadoš, M., Bohdalová, M. (2017). Gender inequality in unemployment by education attainment in Spain, Switzerland and the European union. In: *Education excellence and innovation management through Vision 2020: From regional development sustainability and competitive economic growth*. Norristown, PA: IBIMA, pp. 2512-2526.

Gavurova, B., Kocisova, K., Kotaskova, A. (2017). The Structure – Conduct – Performance Paradigm in the European Union Banking. *Economics & Sociology*, vol. 10(4), pp. 99 - 112.

Chorvatovičová, L., Saxunová, D. (2016). Usefulness of financial statements and annual reports in the process of accounting fraud detection. In: *MIC 2016: Managing global changes: Proceedings of the joint international conference*. Koper: University of Primorska Press, pp. 233-247.

Matuszaka, L., Rozanska, E. (2017). Corporate social responsibility disclosures and financial performance: Evidence from Polish banks. In: *Proceedings of the 12th International Conference Accounting and Management Information Systems (AMIS 2017)*. Bucharest: Bucharest University of Economic Studies, pp. 39 - 57.

OECD (2018). *Banking sector leverage*. Retrieved from: <https://data.oecd.org/corporate/banking-sector-leverage.htm>.

Ray, K. K., Mitra, S. K. (2018). Firm's Financial Performance and Sustainability Efforts: Application of Classifier Models. *Global Business Review*, vol. 19(3), pp. 722 - 736.

The National Bank of Slovakia (2017). *Balance sheet of assets and liabilities*. Retrieved from: <https://www.nbs.sk/en/statistics/financial-institutions/banks/statistical-data-of-monetary-financial-institutions>.

The National Bank of Slovakia (2016). *Analysis of the Slovak Financial Sector 2016*. Retrieved from: https://www.nbs.sk/_img/Documents/_Dohlad/ORM/Analzy/ASFS_2016.pdf.

Life Insurance in the Czech Republic: New Challenges?

Karina Benetti

Technical University of Liberec
Faculty of Economics, Department of Economic Statistics
Studentska 1402/2, 461 17 Liberec, Czech Republic
E-mail: karina.benetti@tul.cz

Abstract: *Do the life insurance products offered on the Czech insurance market provide adequate insurance protection? Life insurance over the last decade has changed greatly, not only in the offer of products. Originally this type of insurance resulted to cover the consequences of the risk of death and life expectancy risk. Products of life insurance covering the risk of death should provide family of in case of death of the breadwinner, products aimed at the risk of life expectancy were mainly-saving products which should primarily secure the individual in old age. It was also possible to arrange a product called endowment assurance. It is worth mentioning that there are various modern variations and possibilities of arranging the different kinds of insurance within the life insurance of people. The product development is escalated in investment life insurance product, which has its strengths, but also weaknesses. It is a question if the situation on the Czech life insurance market with regard to the development and importance of the products of the investment life insurance for the insurance or especially financial market the opportunity or the threat. The main objective of this paper is to capture the main trends of gross life insurance premium, focusing on changes in gross premiums written by individual types of life insurance products including the analysis of selected parameters (number of insurance contracts, insurance penetration and other selected indicators). The software STATGRAPHICS Centurion will be used for this analysis.*

Keywords: *life insurance, development, gross premium written*

JEL codes: *G18, G22*

1 Introduction

The main roles of life insurance in the financial services system are gradually changing. According Ducháčková (2016) the life insurance is considered to be an instrument to cover the needs of people, on the one hand, a tool of covering the consequences of the risk (death and other risks - accident, invalidity, illness etc.), and on the other hand, a tool for savings to cover the needs of people in post-productive age. At present, many factors affect the development of life insurance and especially its efficiency. In the use of life insurance as a means of addressing the needs of people in old age is in the last period on the Czech insurance market a number of problems. The problems, according Ducháčková (2016) arise from the form of life insurance products, from regulatory approaches in life insurance, from approaches to selling life insurance contracts. However, life insurance is a standard tool of the insurance (financial) market (Ducháčková, 2015). Its role, significance and form are changing throughout its development in relation to changing conditions of life insurance. It is characteristic for the recent period that life insurance has been going through modifications, in particular the typical increase in the share of unit linked life insurance which is representing in particular the product of the investment life insurance. Life insurance and especially unit linked life insurance have been recently facing a few challenges. Some of them resulted from changing financial markets and others were connected with the conclusion of life insurance policies.

The aim of the paper is to analyze the development of the gross premium written of life insurance in the Czech Republic and the basic groups of life insurance products by analyzing selected indicators for the period 1995 to 2017.

In the following part research methods and data for analysis will be characterized.

2 Methodology and Data

In the research were particular used scientific methods: induction, comparative analysis, synthesis of partial knowledge, elementary statistical analysis and dependence analysis.

For elementary statistical analysis the following selected indicators were used (Hindls, et al., 2000):

- the first difference

$$\Delta_t^{(1)} = \Delta_t - \Delta_{t-1} . \quad (1)$$

- the second difference

$$\Delta_t^{(2)} = \Delta_t^{(1)} - \Delta_{t-1}^{(1)} \quad (2)$$

- the growth coefficient

$$k_t = \frac{y_t}{y_{t-1}} \quad (3)$$

- the growth rate

$$\delta_{y_t} = T_{y_t} - 100 \quad (4)$$

- the increase rate

$$T_{y_t} = k_t \cdot 100 \quad (5)$$

- the average absolute gain and

$$\bar{\Delta} = \frac{\sum_{t=2}^n \Delta_t}{n-1} = \frac{y_n - y_1}{n-1}, \quad (6)$$

- the average growth coefficient

$$\bar{k} = \sqrt[n-1]{\frac{y_n}{y_1}} \quad (7)$$

where n is the number of values (in this paper $n = 23$).

For regression analysis was used software STATGRAPHICS Centurion XVI. For the analysis secondary data from Czech National Bank (2018) were used.

According to the results of an elementary statistical analysis a suitable model for trend analysis will be chosen. The results of trend analysis will be evaluated based on their individual indices:

- RMSE (root mean squared error);
- R_M^2 modified index of determination;
- p-value (of parameters and model) of significance, according to which the robustness of a particular model is evaluated at the 5% significance level;
- t-test,
- F-ratio of model.

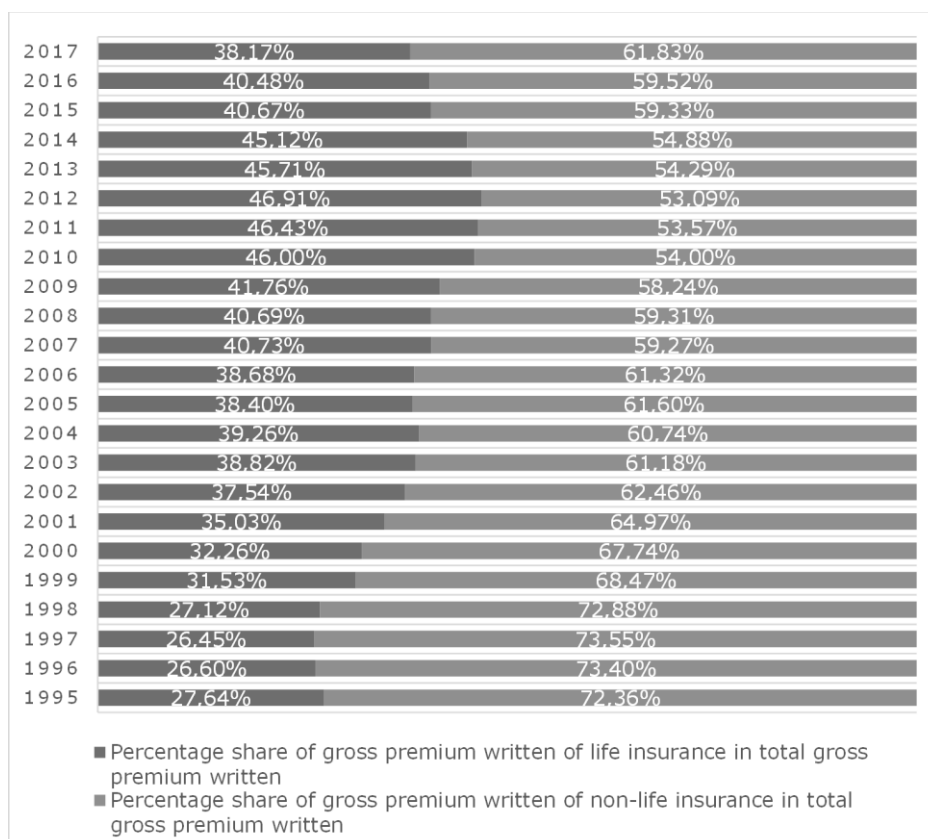
Other indicators that will assess the development of life insurance in the Czech Republic will include, in particular: development of number of insurance contracts, insurance penetration, gross premium written in life insurance per capita and the ratio of the individual life insurance groups (insurance relate to an investment fund, wedding insurance or child-care insurance, accident insurance or sickness insurance, retirement insurance, death and survival insurance) to the total prescribed life insurance in the Czech Republic.

3 Results and Discussion

The results of elementary statistical analysis, by selected characteristics, of development of gross premium written in life insurance are given below. The development of the

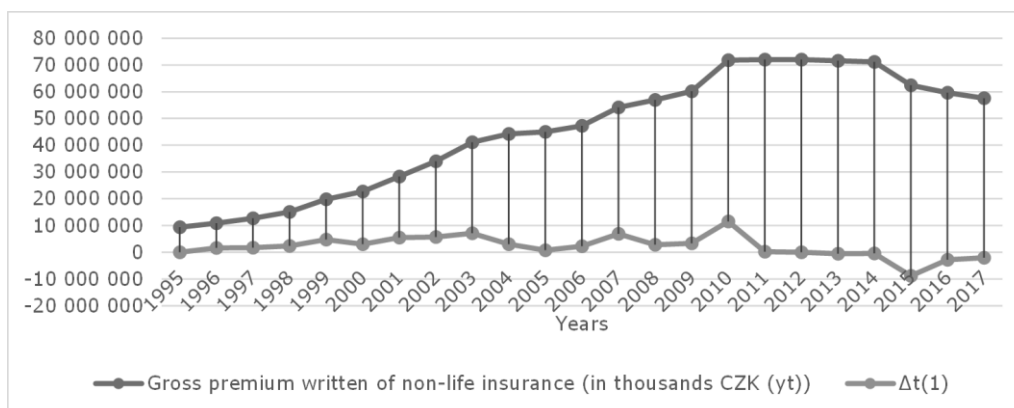
percentage ratio of gross premium written in life insurance versus non-life insurance is illustrated in Figure 1. This figure shows the importance of life insurance on the Czech insurance market. It should be added that this ratio is reversed on average across the EU (see Eurostat data). The basic development of gross premium written in life insurance of its first difference illustrated Figure 2 and Table 1.

Figure 1 Development of The Percentage Ratio of Gross Premium Written in Life Insurance Versus Non-life Insurance



Source: own from Czech National Bank (2018)

Figure 2 Development of Premium Written in Life Insurance with Development of its First Difference



Source: own from Czech National Bank (2017)

According to the development of the values specified in Figure 1 can be deduced that the observed characteristics recorded growth till 2014. For this reason, does not make sense to describe the examined values other statistical characteristics (such as e.g. coefficient growth, growth rate and increase rate). For a basic overview of the development of the

examined values sufficient to indicate the results of absolute average gain and average growth coefficient.

The result of average absolute gain is for gross premium written in life insurance CZK 2 192 694 (for year 2016 was CZK 2 392 810 520, Benetti (2017)).

The result of average growth coefficient is for gross premium written in life insurance 1.086181458 (for year 2016 it was 1.092248, which corresponds to 9.23 %, Benetti (2017)).

Table 1 Elementary Characteristic Development of Gross Premium Written in Life Insurance

Years (t)	Gross premium written of non-life insurance (in thousands CZK (y_t))	$\Delta_t^{(1)}$	$\Delta_t^{(2)}$	k_t	T_{yt}	δ_{yt}
1995	9 341 715	x	x	x	x	x
1996	10 937 216	1 595 501	x	1.170793157	0.170793157	17.08%
1997	12 692 286	1 755 070	159 569	1.16046771	0.16046771	16.05%
1998	15 089 372	2 397 086	642 016	1.188861644	0.188861644	18.89%
1999	19 793 331	4 703 959	2 306 873	1.311739879	0.311739879	31.17%
2000	22 770 132	2 976 801	-1 727 158	1.15039414	0.15039414	15.04%
2001	28 281 966	5 511 834	2 535 033	1.242064209	0.242064209	24.21%
2002	34 036 346	5 754 380	242 546	1.203464639	0.203464639	20.35%
2003	41 128 802	7 092 456	1 338 076	1.20837889	0.20837889	20.84%
2004	44 201 009	3 072 207	-4 020 249	1.074697216	0.074697216	7.47%
2005	44 954 269	753 260	-2 318 947	1.017041692	0.017041692	1.70%
2006	47 233 389	2 279 120	1 525 860	1.050698633	0.050698633	5.07%
2007	54 128 225	6 894 836	4 615 716	1.145973773	0.145973773	14.60%
2008	56 909 094	2 780 869	-4 113 967	1.051375581	0.051375581	5.14%
2009	60 209 323	3 300 229	519 360	1.057991241	0.057991241	5.80%
2010	71 764 862	11 555 539	8 255 310	1.191922753	0.191922753	19.19%
2011	72 009 104	244 242	-11 311 297	1.003403365	0.003403365	0.34%
2012	72 049 292	40 188	-204 054	1.000558096	0.000558096	0.06%
2013	71 577 033	-472 259	-512 447	0.993445335	-0.006554665	-0.66%
2014	71 186 464	-390 569	81 690	0.994543375	-0.005456625	-0.55%
2015	62 415 277	-8 771 187	-8 380 618	0.876785747	-0.123214253	-12.32%
2016	59 590 736	-2 824 541	5 946 646	0.954745999	-0.045254001	-4.53%
2017	57 580 983	-2 009 753	814 788	0.966274	-0.03373	95.47%

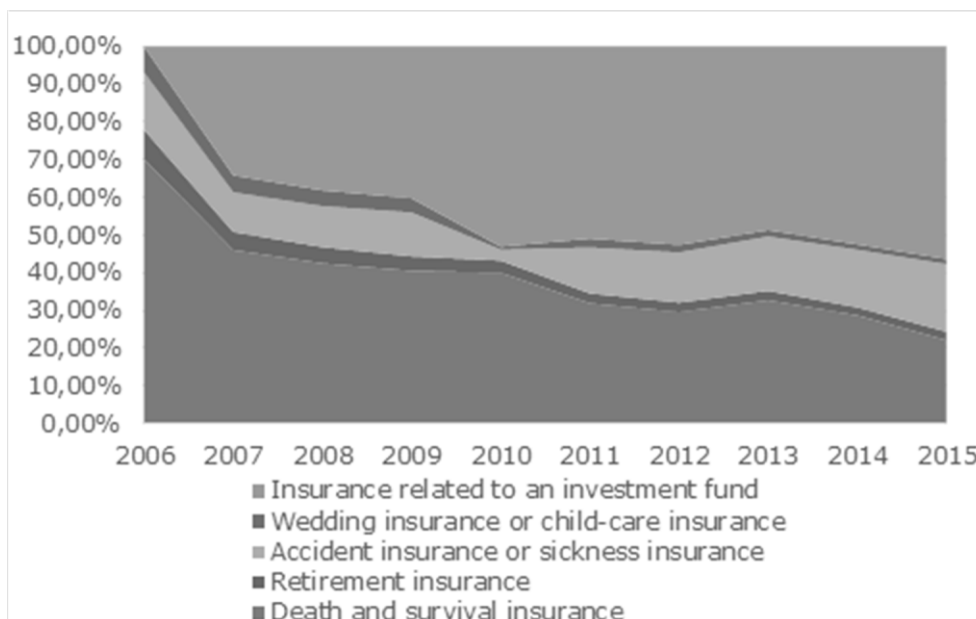
Source: own elaboration Czech National Bank (2018)

From Table 1 it is clear that the largest increase was recorded in the surveyed quantity in 2010, on the contrary, the largest decline in 2015. The question is which life insurance group this increase / decrease was caused. This will be the focus below.

The results of the ratio of the individual life insurance groups (insurance relate to an investment fund, wedding insurance or child-care insurance, accident insurance or sickness insurance, retirement insurance, death and survival insurance) to the total prescribed life

insurance in the Czech Republic are shown in the Figure 3. The data for ends of years 2016 and 2017 was not published.

Figure 3 The Development of the Ratio of the Individual Life Insurance Groups to the Total Premium Written in Life Insurance in the Czech Republic



Source: own elaboration from Czech National Bank (2018)

From Figure 3 it is clear that the increase in the total life insurance premium written in 2010 was driven by an increase in subscribed life insurance premiums linked to the investment fund. On the other hand, the decline in total life insurance premiums written in 2015 was due to a decline in written life insurance premiums in the event of death and survival, as well as a partial decline in gross written premium written linked to the investment fund.

The results of development of number of insurance contracts, insurance penetration and gross premium written in life insurance per capita see in Table 2.

The number of the insurance contract has a decreasing trend over the reference period, except 2012. However, the gross premium written per insurance contract has a volatility development period. This means that with the decreasing number of contracts, the gross premiums written not decreases. Premium per capita increases in the period 2006 to 2011, and in the following year, since 2012, it has declined. In the case of this indicator, it is highly desirable for its value to have a growth tendency. The decreasing trend of this indicator indicates the low use of the product by the population of that country. Insurance penetration a growing tendency in 2006 to 2010, with a downward trend in the following period since 2006, indicating the unfavorable development of the indicator.

Another research question is how to develop gross premiums written in life insurance in the future this will be used to analyze time series and software STATGRAPHICS Centurion XVI. The trend in time series can be described by trend functions unless the development of time series corresponds to a particular function of time (for example: linear, quadratic and exponential).

Table 2 The Results of Selected Indicators

	2006	2007	2008	2009	2010
Number of insurance contracts	10 010 546	10 119 438	10 104 445	9 349 600	8 919 070
Gross premium written per insurance contract	4 718	5 349	5 631	6 442	8 046
Premium per capita	4 601	5 243	5 456	5 741	6 824
Insurance penetration	1.35%	1.41%	1.42%	1.54%	1.82%
	2011	2012	2013	2014	2015
Number of insurance contracts	8 675 566	9 357 769	8 060 735	7 740 318	7 392 770
Gross premium written per insurance contract	8 300	7 699	8 880	9 197	8 443
Premium per capita	6 860	6 856	6 810	6 764	5 920
Insurance penetration	1.79%	1.77%	1.75%	1.65%	1.37%
	2016	2017			
Number of insurance contracts	5 996 463	5 865 132			
Gross premium written per insurance contract	9.937.65	9 817.51			
Premium per capita	5 640	5 427			
Insurance penetration	1.25%	1.14%			

Source: own elaboration from (Czech Statistical Office, 2017a and 2017b), (Czech National Bank, 2018)

Linear trend function (line) has the following form (Arlt et al, 2002):

$$T_t = \beta_0 + \beta_1 t \quad (8)$$

Quadratic trend function (parabola) has the following form (Arlt et al, 2002):

$$T_t = \beta_0 + \beta_1 t + \beta_2 t^2 \quad (9)$$

Exponential trend function has the following form (Arlt et al, 2002):

$$T_t = \beta_0 \beta_1^t \quad (10)$$

To evaluate the suitability of the trend have been identified and assessed values of trend function forecast, values of the root mean squared error (RMSE) and values of modified index of determination (R_M^2).

RMSE (Arlt et al, 2002):

$$\text{RMSE} = \sqrt{\frac{1}{T} \sum_{t=1}^T (y_t - \hat{y}_t)^2} \quad (11)$$

where \hat{y}_t is modeled values at time t.

Determination modified index (R_M^2), (Arlt et al, 2002):

$$R_M^2 = R^2 - \frac{(1-R^2)(k-1)}{T-k} \quad (12)$$

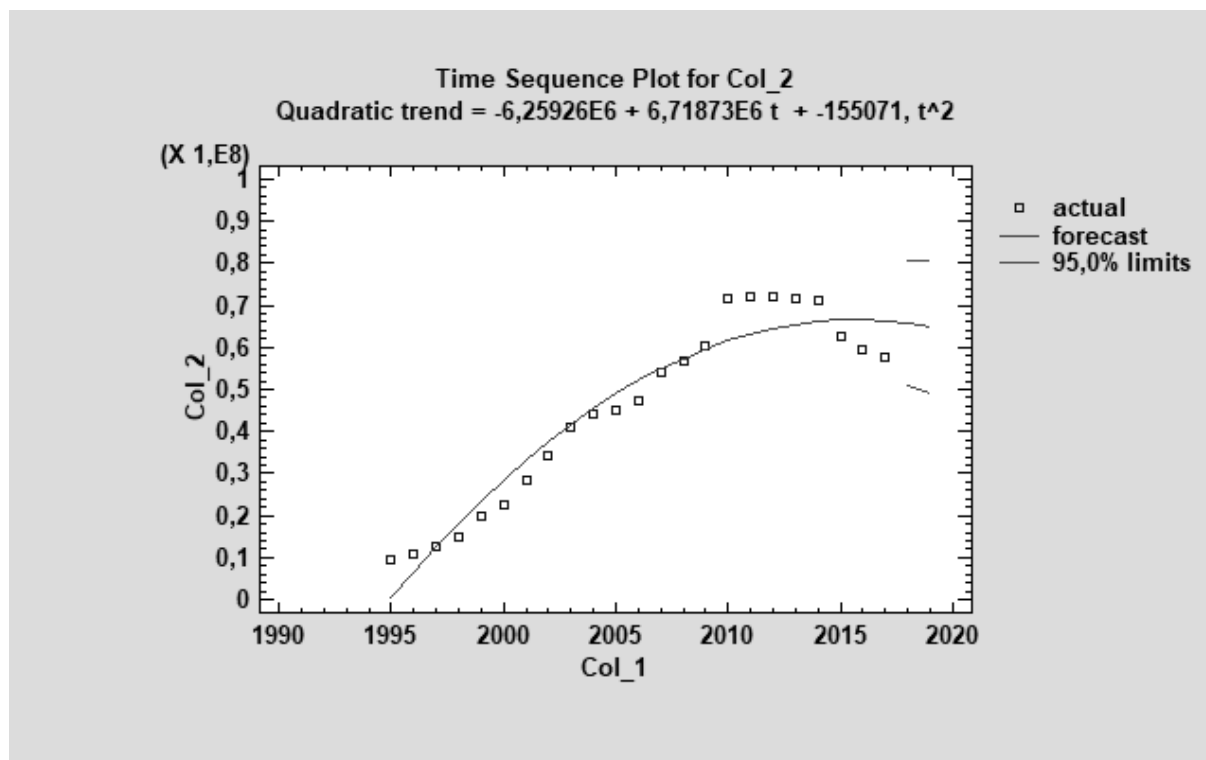
Other indicators used for trend analysis include: p-value, t-test and F-ratio. Based on the results of these indicators, using the software STATGRAPHICS Centurion XVI was selected the best model – quadratic trend.

Trend function forecast is: $\hat{T}_t = -6\,259\,260\,000 + 6\,718\,730\,000t - 155\,071t^2$.

Forecast for next two periods is – point for year 2018 CZK 65 669 400 000 (interval CZK: 50 955 300 000 – 80 038 360 000) and point for year 2019 CZK 64 789 700 000 (interval CZK: 49 183 000 000 – 80 396 400 000). Compared with results of previous published

analysis (Benetti, 2018) the point estimation was for year 2017 CZK 70 511 000 000 (interval CZK: 56 552 400 000 – 84 471 300 000) and point for year 2018 CZK 70 729 300 000 (interval CZK: 55 850 200 000 – 85 608 400 000). The estimation for year 2017 was 13 148 317 000 higher.

Figure 4 Time Series Equalization by Quadratic Trend and Forecast of Development for Next Two Years



Source: own elaboration

4 Conclusions

The predicted development of the gross premiums written in life insurance according to the selected time series model for the following two periods – 2018 and 2019 – has a decreasing tendency. If the model prediction would be fulfilled, it would indicate a positive development in the use of life insurance products. However, it is questionable whether declining trends in the use of traditional life insurance products, death and survival insurance, rather than suggesting a change in clients' interest in other products – such as the life insurance product linked to the investment fund. On the contrary, the increase in the use of life insurance products that are linked to the investment fund does not necessarily imply a positive development in the use of life insurance products, as the investment life insurance products are not the classic investment products but rather the investment instrument (when the reasonable amount for the risk of death is not met). This could be a basic research question for further research. From the above results, it can be assumed that the development of written life insurance has unhealthy development on the Czech insurance market. The situation with the investment life insurance product is very unstable. From the results above, it can be assumed that the development of written life insurance has unhealthy development on the Czech insurance market. The situation with the investment life insurance product is very unstable. Already in the press, information was received in the press that many clients of insurance companies are suing for the invalidity of the investment product life insurance product. Not only from this point of view can the product of investment life insurance be more a threat than a market opportunity.

Acknowledgments

The paper was written under the support of the specific research of EF TUL.

References

Arlt, J. et al. (2002). *Analýza ekonomických časových řad s příklady*. Vysoká škola ekonomická v Praze, 2002.

BENETTI, K. (2017). The Development of Gross Premiums Written in Life Insurance in the Czech Republic. In: *Proceedings of the 14th International Scientific Conference European Financial Systems 2017*. Brno: Masaryk University, pp. 15-22. ISBN 978-80-210-8609-8. WOS: 000418110700002.

Czech National Bank (2018). *ARAD*. http://www.cnb.cz/docs/ARADY/HTML/index_en.htm

Czech Statistical Office (2017a). *Population – annual time series*. https://www.czso.cz/csu/czso/population_hd

Czech Statistical Office (2017b). *Gross domestic product – time series*. https://www.czso.cz/csu/czso/hdp_ts

Ducháčková, E. (2016). The Role of Life Insurance in the Context of Cover the Needs of the People in the Czech Republic. In: *Proceedings of the 13th International Scientific Conference European Financial Systems 2016*. Brno: Masaryk University, pp. 133–140. WOS: 000385692200017

Ducháčková, E. (2015). Life Insurance and the Role of Financial Arbitrator for the Resolution of Disputes within Life Insurance. In: *7th International Scientific Conference on Finance and Performance of Firms in Science, Education and Practice*. pp. 217–231. WOS: 000374107300016

Hindls, R. et al. (2000). *Statistika pro economy*, 8th ed. Praha: Professional Publishing.

Corporate Bankruptcies in the Czech Republic: The Development Over the Last Decade

Karina Benetti

Unicorn College s.r.o.
V Kapslovne 2767/2, 130 00 Praha 3, Czech Republic
E-mail: benetti.kari@gmail.com

Abstract: *This paper deals with the analysis of development of corporate bankruptcies in the Czech Republic over the last decade. Corporate bankruptcies are an inherent element of the market economy. In the Czech Republic in 2006 was published a law no. 182/2006 Coll., On Bankruptcy and Its Resolution (Insolvency Act), which came into effect from January 1st, 2008. This law came into effect just at a time when the new financial crisis started getting stronger. This crisis has affected the development of corporate bankruptcies not only in the Czech Republic but also in other countries. Corporate Bankruptcies (Mączyńska, 2009) are the necessary selection mechanism in the world of business and have an important rationalizing function – they rid the market of entities that are unable to meet the appropriate efficiency requirements. The aim of this paper is to analyze the development of corporate bankruptcies – the comparison between the development of corporate insolvency proposals and corporate bankruptcies (using total and monthly data) in the Czech Republic over the last decade – in the period 2008 to 2017 with a forecast for 2018. The software STATGRAPHICS Centurion will be used for this analysis. The data needed to analyze the development of corporate insolvency proposals and corporate bankruptcies has been taken over from the company Creditreform, s.r.o. Czech Republic.*

Keywords: *corporate bankruptcy, corporate insolvency proposals, development, financial health.*

JEL codes: G31, G33

1 Introduction

From January 1st, 2008 the law no. 182/2006 Coll., On Bankruptcy and Its Resolution (Insolvency Act), which was published in 2006 came into effect. This law regulates not only bankruptcies of companies, but also personal bankruptcies. In the Czech Republic Bokšová and Randáková (2015), Bokšová et al (2014), Hospodka et al (2015) and Maixner et al (2014) published analysis results of personal bankruptcies in recent years. In this view bankruptcy models (Čámská, 2012) and basic characteristics of enterprises, which are in insolvency (Čámská, 2013), are very important. The analysis of the business property's changing trends of the entity should be one of the most important tasks of the financial analysis for the assessment of the financial situation of the enterprise (Pakšiová, 2017). Detailed analysis of corporate insolvency during the crisis years (with data analysis from 2008 to 2013) were published by Kislingerová and Schoenfeld (2014), Benetti (2016 a, 2016 b and 2017) and forecasts of corporate insolvencies for the period 2013–2017 were published in 2013 by Kislingerová (2013), Benetti (2017). However, no one has engaged in research of corporate bankruptcies within individual regions in the Czech Republic and their effects on their development (or economic performance).

The aim of this paper is to analyze the development of (using total and monthly data) corporate bankruptcies – the comparison between the development of corporate insolvency proposals (it means according to the law no. 182/2006 Coll., at the insolvency court filed a petition to initiate insolvency proceedings) and corporate bankruptcies (it means according to the law no. 182/2006 Coll., the debtor is in bankruptcy, if he has more than one creditor, a pecuniary obligation for more than 30 days after maturity, and he is not able to repay at the same time) in the Czech Republic over the last decade – in the period 2008 to 2017 with a forecast for 2018. The software STATGRAPHICS Centurion will be used for this analysis. The data needed to analyze the development of corporate insolvency

proposals and corporate bankruptcies has been taken over from the company Creditreform, s.r.o. Czech Republic.

2 Methodology and Data

In the research, scientific methods were particular used: induction, comparative analysis, synthesis of partial knowledge, elementary statistical analysis and dependence analysis.

For elementary statistical analysis were used the following selected three indicators (Hindls, et al, 2000):

- the first difference (absolute gain, ${}_1\Delta_t$ IN – for corporate insolvencies and ${}_1\Delta_t$ BA – for corporate bankruptcies) (1)

$${}_1\Delta_t = \Delta_t - \Delta_{t-1} \quad (1)$$

- the average absolute gain (2) and

$${}_1\bar{\Delta} = \frac{\sum_{t=2}^n {}_1\Delta_t}{n-1} = \frac{y_n - y_1}{n-1}, \quad (2)$$

- the average growth coefficient (3)

$$\bar{k} = \sqrt[n-1]{\frac{y_n}{y_1}} \quad (3)$$

where n is the number of values (in this paper n = 120).

For the dependence analysis, the software STATGRAPHICS Centurion XVI was used. For the analysis were used secondary data from Creditreform (2017).

3 Results and Discussion

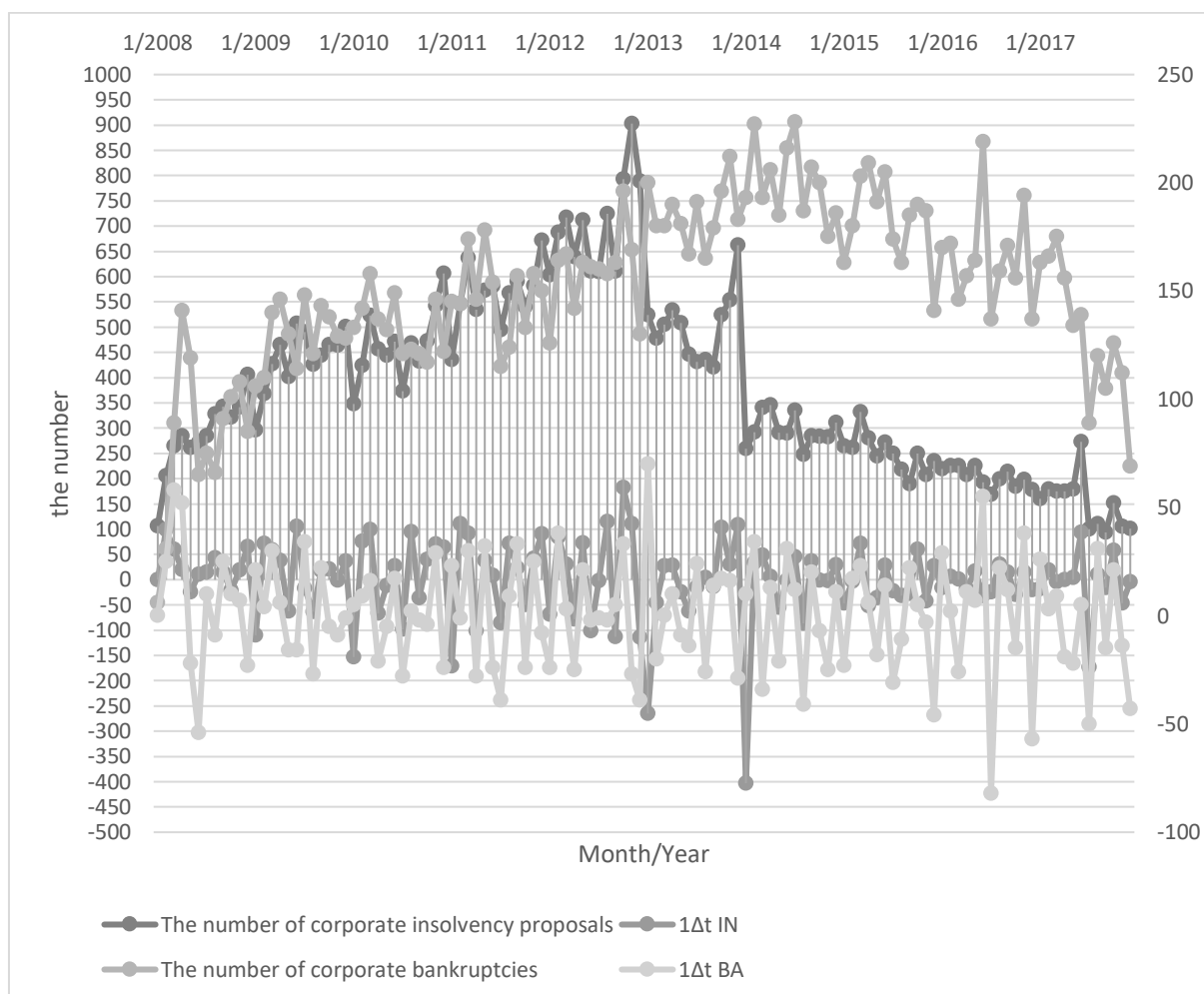
The results of elementary statistical analysis, by selected three characteristics, of development of number of corporate insolvency proposals and corporate bankruptcies are given below. The basic development of number of corporate insolvency proposals and corporate bankruptcies with development of its first difference illustrates Figure 1.

According to the development of the values specified in Figure 1 can be deduced that the observed characteristics were examined over a period of very fluctuating development. For this reason, does not make sense to describe the examined values other statistical characteristics (such as e.g. coefficient growth, growth rate and increase rate). For a basic overview of the development of the examined values sufficient to indicate the results of absolute average gain and average growth coefficient.

The result of average absolute gain is for corporate insolvencies proposals -0.04202 and for corporate bankruptcies 0.529412.

The results of average growth coefficient are for corporate insolvencies proposals 0.999594 (which corresponds to -0.0406%). and for corporate bankruptcies 1.020736 (which corresponds to 2.0736%).

Figure 1 Development of Number of Corporate Insolvency Proposals and Corporate Bankruptcies with Development of its First Difference



Source: author from Creditreform (2018)

The automatic forecasting function was used for the forecasting of the corporate insolvency proposals and corporate bankruptcies in Czech Republic. The ARIMA (0,1,2) model was selected for the forecasting of the corporate insolvency proposals by the results of the p-value, the standard error, the root mean squared error (RMSE), the mean absolute error (MAE), the mean absolute percentage error (MAPE), the mean error (ME) and the mean percentage error (MPE). The results of selected indicators for different ARIMA models see in Table 1. Forecasted values of number of corporate insolvency proposals for the Czech Republic for January 2018 was point value 113.219 and from February to June 2018 was 115.449. The number of corporate insolvency proposals which was reported (Creditreform, 2018) for January 2018 was 121. The forecast by the selected model was accurate only 95.04 %, which corresponds to the selected confidence interval. The number of corporate insolvency proposals which was reported for February was 112 and for March 131 (Creditreform, 2018). The forecast by the selected model was accurate only 85.7 % for values in February, which corresponds to the selected confidence interval. The forecast by the selected model was accurate only 64.95 % for values in March, which does not corresponds to the selected confidence interval. If we change in the program Statgraphics the analysis options – by the ARIMA models we not optimize model order and not optimize parameters. By the using of function of automatics forecasting options we have another result – the ARIMA (2,2,2) model was selected with forecasting for January 2018 in value 111, for February 2018 in value 100 and for March 2018 in value 97. The forecast by the selected model was accurate only 90.99 % for values in January, 88.00 % for values in February and 64.95 %, which does not corresponds to the selected confidence interval.

Table 1 Results of Selected Indicators for Different ARIMA Models

MODEL	RMSE	MAE	MAPE	ME	MPE
ARIMA(0,1,2)	71.2976	51.2254	14.9138	-0.51787	-3.39436
ARIMA(1,1,1)	71.7079	51.248	14.8673	-0.47211	-3.383
ARIMA(2,1,0)	71.9718	49.4441	14.562	-0.20137	-2.99306
ARIMA(2,1,1)	71.4841	50.8454	14.7782	-0.51198	-3.33274

Source: author

For the forecasting of the corporate bankruptcies was by the results of the p-value, the standard error, the root mean squared error (RMSE), the mean absolute error (MAE), the mean absolute percentage error (MAPE), the mean error (ME) and the mean percentage error (MPE) selected ARIMA (0,2,2) model. Results of selected indicators for different ARIMA models see in Table 2.

Table 2 Results of Selected Indicators for Different ARIMA Models

MODEL	RMSE	MAE	MAPE	ME	MPE
ARIMA(0,2,2)	22.4576	16.9632	12.5779	-3.29357	-3.93513
ARIMA(0,1,1)	22.7724	17.2389	12.6029	1.45102	-0.556413
ARIMA(0,1,2)	22.6982	17.1836	12.4361	1.55363	-0.407813
ARIMA(1,1,1)	22.7337	17.1974	12.4608	1.57738	-0.393204

Source: author

Forecasted values of number of corporate bankruptcies for the Czech Republic in January 2018 was point value: 100, for February 2018 was 98, for March 2018 was 95. The number of corporate bankruptcies which was reported for January 2018 was 83, for February was 84 and for March 120 (Creditreform, 2018). The forecast by the selected model was accurate only 83.00 % for values in January, 85.7 % for values in February and 79.2 % for values in March, which does not corresponds to the selected confidence interval. If we change in the program Statgraphics the analysis options – by the ARIMA models we not optimize model order and not optimize parameters. By the using of function of automatics forecasting options we have another result – the ARIMA (2,2,2) model was selected with forecasting for January 2018 in value 88, for February 2018 in value 83 and for March 2018 in value 76. The forecast by the selected model was accurate only 95.40 % for values in January, 98.81 % for values in February and 79.2 %, which corresponds to the selected confidence interval. For values in March was the forecast by the selected model accurate only 63.33 %, which does not corresponds to the selected confidence interval.

For dependence analysis will be used monthly data. Firstly, was conducted multiple variable analysis, summary statistics illustrated Table 3, results from correlations show Table 4 and Figure 2.

The Table 1 shows summary statistics for each of the selected data variables. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate many of the statistical procedures normally applied to this data.

Table 3 The Summary Statistics from Multiple Variable Analysis

	The Number of Corporate Insolvencies Proposals	The Number of Corporate Bankruptcies
Count	120	120
Average	385.1	151.35
Standard deviation	177.151	39.4337
Coefficient of variation	46.0014%	26.0547%
Minimum	94.0	6.0
Maximum	903.0	228.0
Range	809.0	222.0
Standard skewness	2.02242	-3.26109
Standard kurtosis	-1.02139	2.61712

Source: own elaboration

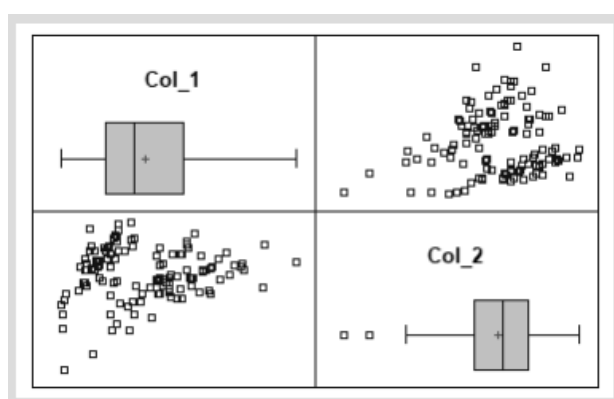
Table 4 Correlation

	The Number of Corporate Insolvencies Proposals	The Number of Corporate Bankruptcies
The Number of Corporate Insolvencies Proposals		0.1337 (Correlation) (120) (Sample Size) 0.1454 (P-Value)
The Number of Corporate Bankruptcies	0.1337 (Correlation) (120) 0.1454	

Source: own elaboration

The Table 4 shows Pearson product moment correlations between each pair of variables. In this case is Pearson product moment correlation 0.1337. Pearson product moment correlation coefficients range between -1 and +1 and measure the strength of the linear relationship between the variables. Also shown in parentheses is the number of pairs of data values used to compute each coefficient. The third number in each location of the table is a P-value which tests the statistical significance of the estimated correlations. P-values below 0.05 indicate statistically significant non-zero correlations at the 95.0% confidence level. None form the analyzed pairs of variables have P-values below 0.05. This is the reason, why is for this case the Pearson product moment correlations indicator not correct, we must use for example Spearman correlation coefficient.

However, the results shown in Table 4 cannot be properly assessed without visualization - see Figure 2.

Figure 2 Scatterplot Matrix

Source: own elaboration

Note:

Col_1 = The Number of Corporate Insolvencies Proposals

Col_2 = The Number of

From the results in the Figure 2 it is evident that between variables is no correlation. Certainty as to whether between variables is or is not correlation will bring a result of the Spearman rank correlation, the results are given in Table 5.

Table 5 Spearman Rank Correlations

	The Number of Corporate Insolvencies Proposals	The Number of Corporate Bankruptcies
The Number of Corporate Insolvencies Proposals		0.0650 (Correlation)
		(120) (Sample Size)
		0.4781 (P-Value)
The Number of Corporate Bankruptcies	0.0650 (Correlation)	
	(120) (Sample Size)	
	0.4781 (P-Value)	

Source: own elaboration

This table shows Spearman rank correlations between each pair of variables. These correlation coefficients range between -1 and $+1$ and measure the strength of the association between the variables. In contrast to the more common Pearson correlations, the Spearman coefficients are computed from the ranks of the data values rather than from the values themselves. Consequently, they are less sensitive to outliers than the Pearson coefficients. Also shown in parentheses is the number of pairs of data values used to compute each coefficient. The third number in each location of the table is a P-value which tests the statistical significance of the estimated correlations. P-values below 0.05 indicate statistically significant non-zero correlations at the 95.0% confidence level. None from the analyzed pairs of variables have P-values below 0.05.

From the above analysis results, it is clear that it has not been proved dependence between the number of corporate insolvencies proposals and the number of corporate bankruptcies.

4 Conclusions

This paper had as objective: firstly, to describe the development of the number of corporate insolvencies proposals and the number of corporate bankruptcies in the Czech Republic over the last decade – in the period 2008 to 2017 with a forecast for 2018. Secondly, analyze the dependence between these examinees variables. From the results of the analysis, it is clear that the development of the examined variables during the monitored period was highly variable (fluctuating). Dependence between examined variables could not be prove.

For further research is recommended detailed analysis of corporate insolvencies proposals and corporate bankruptcies by region and then also in terms of business sectors.

Acknowledgments

This paper was created with the support of specific research in Unicorn College s.r.o.

References

- Benetti, K. (2016 a). Bankruptcies of Companies in the Czech Republic after New Financial Crisis. In: *Proceedings of the 13th International Scientific Conference European Financial Systems 2016*. Brno: Masaryk University, pp. 21–25.
- Benetti, K. (2016 b) The Corporate Insolvency Proposals in The Czech Republic after The Financial Crisis. In: *4th International Virtual Conference on Advanced Scientific Results (SCIECONF-2016)*. pp. 98-100. DOI: 10.18638/scieconf.2016.4.1.374.

Benetti, K. (2017). Company Bankruptcies: the Overall Development in the Czech Republic, Including Comparison of its Development by the Regions. In: *11th International Days of Statistics and Economics*. Prague: University of Economics, pp. 97-104. ISBN 978-80-87990-12-4.

Bokšová, J., Randáková, M. (2015). Personal bankruptcies of individuals in the Czech Republic. In: *Proceedings ICABR 2015*. Brno: Mendel University, pp. 460-469.

Bokšová, J., Randáková, M., Hospodka, J., Maixner, J. (2014). Personal bankruptcies of individuals in the Czech Republic in relation to different groups of creditors. In: *Managing and Modelling of Financial Risks*. Ostrava: VSB – Technical University of Ostrava, pp. 80-86.

Čámská, D. (2012). National View of Bankruptcy Models. In: *6th International Days of Statistics and Economics*. Praha: University of Economics, pp. 268-278.

Čámská, D. (2013). Basic Characteristics of Enterprises in Insolvency. In: *Hradecké ekonomické dny 2013 – Ekonomický rozvoj a management regionů, díl I*. Hradec Králové: Gaudeamus, pp. 83-88.

Creditreform (2018). Vývoj insolvencí v České republice. Retrieved from: www.creditreform.cz.

Hindls, R., Hronová, S., Novák, I. (2000). *Metody statistické analýzy pro ekonomy*. Praha: Management Press.

Hospodka, J., Buben, O., Randáková, M., Bokšová, J. (n.d.). Personal Bankruptcy in the Capital City Region and South Bohemian Region in the Czech Republic. In: *16th Annual Conference on Finance and Accounting*. Prague: University of Economics, pp. 41-52.

Kislingerová, E. (2013). Estimated development of the number of filings for insolvency and declared bankruptcies in the Czech Republic between 2013 and 2017. In: *Financial Management of Firms and Financial Institutions: 9th International Scientific Conference Proceedings*. Ostrava: VSB – Technical University of Ostrava, pp. 356-366.

Kislingerová, E., Schoenfeld, J. (2014). The development of insolvency in the entrepreneurial sphere in the Czech Republic during the crisis years. In: *Managing and Modelling of Financial Risks*. Ostrava: VSB – Technical University of Ostrava, pp. 367-378.

Maćczyńska, E. (2009). Corporate Bankruptcies – Disfunctions, Their Causes. *Research Papers Collection*, vol. 2(2), pp. 195-209.

Maixner, J., Hospodka, J., Randáková, M., Bokšová, J. (2014). Personal Bankruptcy in the South Bohemian Region in the Czech Republic. In: *International Conference on Accounting, Auditing, and Taxation. (ICAAT 2014)*. pp. 105-111.

Pakšiová, R. (2017). The critical analysis of profit for its allocation decision-making. *Scientific Annals of Economics and Business*, vol. 64 (Specialissue), pp. 41-56.

Retirement Decisions of Seniors in Poland in the Light of the Qualitative Research

Kamila Bielawska

University of Gdansk
Faculty of Management, Department of Banking and Finance
Armii Krajowej 101, 81-824 Sopot, Poland
E-mail: kamila.bielawska@ug.edu.pl

Abstract: *Although the Polish economy, labour market and retirement system have been going through serious changes over the last thirty years, the effective retirement age in Poland is still relatively low. The aim of the paper was to evaluate if the main reasons to retire among Polish pensioners have been changing through time. The analysis is based on the qualitative research carried out in November 2017 in a form of individual in-depth interviews (IDI) with seniors in different age groups (65-74; 75-84; 85+) for whom the old-age pension is a main source of income. Preliminary results have shown that seniors, despite of their age, tended to retire as soon as possible. Respondents aged 65-74 often indicated that during retirement they were continuing economic activity for a few years and some of them, who quickly retired and did not continue their work, expressed the opinion that from the perspective of time it was a wrong decision. Seniors in older ages (75+) reported disability or health problems as an important reason of early retirement and leaving the labour market (transition from disability pension to old-age pension was treated as a natural path). This factor was less visible in opinions of younger retirees. Few of them pointed out that they retired as they wanted to take the advantage of a leisure time. A retrospective look at pension decisions indicated as the results of the conducted study may provide some interesting conclusions for public policies in the field of pension systems.*

Keywords: *retirement, decisions, Poland, effective retirement age*

JEL codes: *D1, H55, J22, J26*

1 Introduction

The process of inactivation of older workers is complex and influenced by different factors: individual features (health status, competencies, values and motivations) and institutional determinants of working lives, i.e. statutory retirement age (see i.e.: Barnes-Farrell, 2003; Chłóń-Domińczak, 2017; Riedel and Hofer, 2013). The institutional factors, as recognized in many studies (see i.e.: Blondal and Scarpetta, 1998; Duval, 2003; Bassanini and Duval, 2006), were important obstacles in prolonging working lives of workers.

Since the early nineties of 20th century, Polish pension system has faced several reforms, of which the most important was the reform of 1999. This reform changed the structure (from mono to multi-pillar system), pension formula and methods of financing pensions (Bielawska et al., 2015). There are still few subsystems for military service, judges, prosecutors and farmers but the main mandatory retirement scheme covers most economically active people in Poland (non-agricultural workers, contractors and self-employed). The pension formula has been changed from DB to DC (NDC in the first public pillar) but in fact it is a hybrid solution as it still provides the guarantee of the minimum pension in its mandatory part for insured persons having minimum period of insurance (20 years women and 25 years men). The early retirement has been successively phased out and limited to miners. The NDC formula was expected to keep people longer in employment and more eager to postpone retirement as it increases pension wealth (Palmer, 1999; Holzmann, 2017). For full-career workers with average earnings it provides adequate pensions, but those with shorter employment records or with breaks in careers due to the childbirth or family care which are not sufficiently compensated, increases the likelihood of relative poverty (Chłóń-Domińczak et al., 2012).

Most of the institutional factors of early retirement in Poland has been successfully phased-out. Additionally for a limited period of time, from January 2013 to September 2017, the retirement age started to increase by 3 months each calendar year from the level of 60 years for women and 65 years for men, to reach 61 years 3 months and 66 years 3 months respectively for women and men. Since October 2017 the retirement age in Poland was brought to the 2012 levels, what caused the increase in number of pensioners by 500 thousands). The consequences of decreasing the retirement age in Poland have been widely discussed in the literature also in terms of adequacy of future benefits (Szczepański, 2017).

In this paper, the author investigates the motives determining the retirement decisions of seniors in different age groups in the light of institutional changes in Polish pension system. The paper aims to evaluate ex-post retirement decisions and seeks the answer for the questions if this retrospective view on timing the retirement has been changing through the decades.

2 Methodology and Data

To understand the motives of people in older ages determining their retirement decisions a qualitative research has been conducted in a form of individual in-depth interviews (IDI). Respondents were asked about the date of the retirement and the factors which influenced their retirement decisions. The interviewed persons were asked if they used any social transfers prior to the retirement, if they were entitled to early retirement and had they considered postponing the date of the retirement. The IDI scenario also contained the questions about the financial situation on the retirement, economic activity combined with taking the old-age pension. The qualitative research allowed to investigate the different reasoning leading to retirement decisions. The research also provided the opportunity to get a retrospective overview of undertaken decisions, what according to the knowledge of the author of the paper, is the first attempt of a such kind for the retirees in Poland.

IDI's were conducted between October and November 2017 with 45 seniors, in three age categories:

- 65 - 74 (17 interviews)
- 75 - 84 (16 interviews)
- 85 and more (12 interviews)

For all respondents, the public pension was the main source of income of their households. Seniors who took part in interviews were additionally differentiated by sex, area of residence (urban and rural areas) and number of people in the household. The structure of interviewed seniors reflected a wide range of years spent on retirement that is from 2 to almost 30.

Outcomes of the IDI study presented in this paper are a part of the project titled "Retirement Risk in the Light of the Forecasted Changes of the Demand for Consumption Goods and Services of Seniors in Poland" financed by National Science Centre, Poland (UMO-2016/23/B/HS5/03768).

3 Results and Discussion

The oldest interviewed seniors retired at the beginning of the nineties of the 20th century, the youngest - two or three years ago. The time in which the respondents were approaching or reaching retirement age had an influence on making decisions about retirement.

The main observations from the research indicate that most of the interviewed seniors decided to retire as soon as possible. For many of them it was natural consequence of the disability (especially for the oldest respondents, who were granted the disability pension prior to the retirement). Others linked the moment of retirement (acceleration or delay of the transition from work to retirement) with the level of income, health status, family relationships, as well as external factors, such as possibility to keep the employment in the coming years, bridging programs for people in pre-retirement age, etc.).

Those who had retired in early nineties, indicated that when they met the retirement qualifying conditions, they used them immediately. It was a natural response to the unstable situation on the labour market and the growing number of bankruptcies of enterprises (also these owned by the state). Within this group of the interviewed seniors the invalidity also played a role in retirement decisions. Up to 1997 the criteria for the invalidity pension were liberal and constituted a part of the social and economic policies in the beginning of transition from centrally-planned to market-orientated economy. The disability pensions replaced the invalidity pensions in 1997 and required the evaluation not only the general health status but its influence on the employment possibilities. Therefore, the oldest respondents were pushed into retirement mainly by the situation on the labour market and the health status. In general, they were reconciled with the fact of retirement, then and now they have not seen any other possibility at that time. Some of them also underlined the role of the pressure of the employers and other (younger) workers to leave the workplace. This aspect occurred in the opinions of respondents (also younger ones) despite their professional status, education level or material status. An illustration of this phenomenon may be the following statement of one of the interviewed women: "I had been working in a company in a managerial position. Because of my age (60), an atmosphere in the company was difficult to accept. I felt it seriously harmful".

Between the younger respondents who retired 10-15 years ago the situation was more differentiated. There was a numerous group of retirees who declared that they wanted to use the early retirement or bridging programs to get the benefit as soon as possible, what underlines the institutional factors influencing the retirement. It is worth to mention that early retirement had put restrictions on the possibility to continue employment by the level of income earned. Seniors with poor health or having the relatives with health problems treated the early retirement path as natural. But those with relatively good health often regretted that they left the labour market, because the reemployment was often impossible due to the lack of the competencies in the new workplaces.

Interestingly, a few women participating in the interviews, who resigned from work to take care of their grandchildren, in the ex-post evaluation of timing of retirement indicated that they could continue employment and support their children financially (i.e. by funding the babysitter). This view confirms the hypothesis that the ex-post evaluation of the retirement timing may change among younger cohorts of retirees.

Seniors who retired solely by their will, just to have "time to rest" were a few. There are some necessary conditions, which have to be fulfilled to fully enjoy the retirement, of which the most important are: sufficient income and good health status.

The research indicates that youngest retirees tend to continue employment on full or part-time formal or informal basis even up to reaching the age of 70 or higher. It is an interesting observation as the official statistics of the Social Insurance Institution show that reported periods of employment during retirement last for maximum 24 months after retirement (ZUS 2017). Seniors, who combine the retirement with employment usually are more satisfied with their life, not only in terms of better financial situation. Those who retired when reaching statutory retirement age, as they were pushed into retirement by the younger workers, more often treated it as a loss of opportunities for both sides. They reported that they could share experiences, give advice to younger workers.

It is worth to mention, that the health problems or disability as a main reason for retirement between the youngest respondents was pointed out very rarely.

To provide a broader context for retirement decisions of seniors in Poland, Table 1 presents the changes in effective retirement age. Since the 1999 it has been systematically increasing, what was the result of phasing-out the early retirement and the episode of increase in retirement age (January 2013 – September 2017).

Table 1 Effective Retirement Age in Poland 2000-2016 (Social Insurance System)

Effective retirement age	2000	2005	2010	2015	2016
Men	58.9	58.4	60.1	62.8	63.3
Women	55.9	56.0	59.5	60.1	61.0

Source: Social Security Institution (ZUS)

Over the last seventeen years the effective retirement age increased by 4.4 years for men and 5.1 years for women. This tendency may be stopped by the decrease in statutory retirement age in Poland effective from October 2017. In the end of 2017 the representatives of the government argued that decrease in retirement age was positive as 40% of people who applied for the old-age pension (approximately 200 out of 500 thousands people) were not economically active before claiming a pension. Therefore the earlier access to old-age pension allowed for protection against poverty (old-age pension was higher than other social transfers especially for those, who met the criteria for the minimum guaranteed pension).

In this context it is worth to mention, that the recent study on unemployment of the workers age 50+ in Poland proves, that being close to the point at which they are eligible to receive pension benefits leads individuals 'wait' to fulfil these eligibility criteria instead of making an effort to maintain and facilitate their competencies on the labour market (Gałęcka-Burdziak and Góra 2017). Reversing the increase in retirement age may support this attitude and cause the serious consequences for further generations. The latest Ageing Report (European Commission 2018) confirms, that under "no policy change" scenario the participation rates of men and women in the labour market in all age categories will be lower than EU averages. In the NDC scheme it means that the replacement rates and benefit rates for retirees in Poland may be one of the lowest in the EU.

4 Conclusions

Although the effective retirement age in Poland is still relatively low, the outcomes of individual in-depth interviews with seniors in three age groups show the changing attitude to the retirement. Despite the fact, that interviewed retirees most often indicated that they retired as soon as it was possible, the reasoning for retirement timing and further economic activity is different in particular age groups. Between the oldest respondents, who spent on the retirement 30 years or more, there is a belief that in that time there was no other way for them than early retirement. These decisions were taken in unstable economic environment and were also connected with the health problems (disability).

In the younger groups of respondents the issue of health status was not predominant. They more often declared to continue economic activity on the retirement for 5-10 years. Those of them, who quickly retired and did not continue their work, expressed the opinion that from the perspective of time it was a wrong decision, and few underlined it even though they resigned from work to take care over their grandchildren. It is worth to mention, that the respondents pointed out that still some employers and younger employees are not prepared for the changes in age structure of the labour force and tend to push older workers into retirement.

The results shown in the paper indicate that young retirees are more able and willing to work longer with the respect of their needs and capabilities. There is a need to strengthen the public policies in the area of inclusion the older workers on the labour market and informing about the consequences of early retirement with the NDC formula.

When they lose their earning capability, the low level of pension deriving from relatively early retirement may be not sufficient to cover for basic expenses and thus put a pressure on the increase in other public spending.

Acknowledgments

The research was financed by the National Science Centre, Poland under the agreement No. UMO-2016/23/B/HS5/03768).

References

Barnes-Farrell, J. (2003). Beyond Health and Wealth: Attitudinal and Other Influences on Retirement Decision-Making. In: Adams, G., Beehr T., ed., *Retirement: Reasons, Process and Results*. Springer Publishing Company, pp.159-187.

Bassanini, A., Duval, R. (2006). Employment Patterns in OECD Countries: Reassessing the Role of Policies and Institutions. Paris: *OECD Social, Employment and Migration Working Papers*, no. 35.

Bielawska, K., Chłóń-Domińczak, A., Stańko, D. (2015). *Retreat from Mandatory Pension Funds in Countries of the Eastern and Central Europe in Result of Financial and Fiscal Crisis: Causes, Effects and Recommendations for Fiscal Rules*. Retrieved from: http://uczelnia.sgh.waw.pl/pl/uczelnia/badania/grupy_badawcze/ppg/Documents/NCN%20Sta%C5%84ko%202015/Report%20CEE%20reversals%20-%20final.pdf.

Bielawska K., Pieńkowska-Kamieniecka, S. (2015). Aktualna sytuacja na rynku pracy wśród osób starszych a wiek emerytalny w Unii Europejskiej (The Current Situation of Older Workers on the Labour Market in Poland and the Retirement Age in the European Union). In: Chybalski, F., Marcinkiewicz, E., ed., *Current Issues of Pension Systems: Selected Issues*. Lodz: Publishing House of Lodz University of Technology.

Blöndal, S., Scarpetta, S. (1999). The Retirement Decision in OECD Countries. Paris: *OECD Economics Department Working Papers*, no. 202.

Chłóń-Domińczak, A. (2017). Poles above Age 50: Work and Retirement. In: Myck, M., Oczkowska, M., eds., *Generation 50+ in Poland in the View of Europe: Activity, Health and Quality of Life. Outcomes of the SHARE*. Warsaw: Center for Economic Analysis, pp.65-84.

Chłóń-Domińczak, A., Franco, D., Palmer, E. (2012). The First Wave of NDC Reforms: The Experiences of Italy, Latvia, Poland and Sweden. In: Holzmann, R., Palmer, E., Robalino, D., ed., *Nonfinancial Defined Contribution Pension Schemes in a Changing Pension World*. Washington, D.C.: The World Bank, p. 31.

Duval, R. (2003). The Retirement Effects of Old-Age Pension and Early Retirement Schemes in OECD countries. Paris: OECD.

European Commission (2018). The 2018 Ageing Report. Economic and Budgetary Projections for the EU Member States (2016-2070). *Institutional Paper*, no. 079.

Gałęcka-Burdziak E., Góra, M. (2017). How Do Unemployed Workers Behave Prior to Retirement? A Multi-State Multiple-Spell Approach. *IZA Discussion Paper*, no. 10680.

Holzmann, R. (2017). The ABCs of Nonfinancial Defined Contribution (NDC) Schemes. *IZA. Institute of Labor Economics Policy Paper*, no. 130.

Holzmann, R., Palmer, E., Robalino, D., ed. *Nonfinancial Defined Contribution Pension Schemes in a Changing Pension World*. Washington, DC: The World Bank.

Palmer, E. (1999). Exit from the Labor Force for Older Workers in Sweden: Can the NDC Pension System Help? *The Geneva Papers on Risk and Insurance*, vol. 24 (4), p. 462.

Riedel, M., Hofer, H. (2013). Determinants of the Transition from Work into Retirement. Linz: *NRN Working Paper*, no. 1310.

Social Security Institution (2018). Data from the statistical portal: <http://psz.zus.pl/>

Szczepanski, M. (2017). The Impact of Pension Reforms in Poland on Public Finances. In: *Proceedings of the 22nd International Conference on Theoretical and Practical Aspects of Public Finance*. Prague: University of Economics, pp. 60-66.

Determination and Verification of the Key Assessment Indicators for the Insurance Market by Applying the Decomposition Multi-attribute Methods and Regression Analysis

Martina Borovcová¹, Adéla Špačková²

¹ VŠB – TU Ostrava

Faculty of Economics, Department of Finance
Sokolská třída 33, 702 00 Ostrava, Czech Republic
E-mail: martina.borovcova@vsb.cz

² VŠB – TU Ostrava

Faculty of Economics, Department of Finance
Sokolská třída 33, 702 00 Ostrava, Czech Republic
E-mail: adela.spackova@vsb.cz

Abstract: *The insurance industry is one of the most important sectors of the economy. The insurance market is very much intertwined in the financial markets, therefore assessment of its level is important. The assessment and analysis of the insurance market is done by using selected indicators. The aim of the article is determination and verification of the key assessment indicators for the insurance market by applying the decomposition multi-attribute methods and regression analysis. This paper is focused on the description, verification and application of the multi-attribute decomposition methods AHP and ANP based on the Saaty pair comparison approach. The AHP and ANP methods are described, including the computation procedure. The applicability of the methods is presented at the preferences determination. The linear AHP and nonlinear ANP methods are applied. These methods are applied for insurance market assessment, particularly, for determination of preference indicators for the assessment of the insurance market. We consider importance of setting the ratio for evaluation indicators of the development of the insurance market by applying Saaty methods in the framework of decomposition methods AHP and ANP (insurance penetration ratio, claims frequency ratio, concentration ratio, premium indicator, benefit indicator, number of insurance company indicator and more). Subsequently, a custom regression model is created.*

Keywords: *multi-attribute methods, AHP, ANP, Key Assessment Indicators, Saaty Pair Comparison Approach, regression analysis*

JEL codes: *C02, C4, G2, G11*

1 Introduction

Multicriteria decision-making is one of options, how to choose optimal variant of certain sets of variants. Only very rarely it is possible to find the very optimal variant which meets all specified criteria. The solution of decision-making problem is more often a compromise variant, which meets just the most important criteria, while it does not meet all the specified criteria the best.

It is preferable to take into account more than one decision-making criterion when making the decision. Although may arise a situation, where the choice of options has been used only a single evaluation criteria. Conditions for the quantitative nature of the criteria would then be enough to organize a variant according to the values of the criteria and the variant with the highest or the lowest value would be the best (optimal) option. However, there are relatively a few decision-making problems with monocriterial character. More and more frequently, it is possible to meet with problems, when the solution variants should be assessed using a larger number of evaluation criteria. Such decision-making problems then have the character of multicriteria decision-making. It is necessary to determine the goals of decision-making for the application of methods of function evaluation of variants and criteria of decision-making.

The aim of the article is to describe the multi-attribute methods AHP (analytic hierarchy process) and ANP (analytic network process), and their applications to verify the simplified example of determining weights partial indicators of the evaluation of the development of the insurance market. Qualitative, quantitative and other indicators of the level of the insurance market are considered in the study.

2 Methodology Description of the multicriteria decision making evaluation of alternatives

The aim of the application of the multi-criteria decision making evaluation of variants is primary finding the best (optimal) variant and layout of these variants from the best to the worst. The best option is usually a variant of the compromise. The compromise solution is the least distant one from the ideal variant, or the furthest away from the variants of basal, while the ideal option is the one that has all the criteria with the best possible value. On the contrary, variant with the worst values of the criteria is the basal variant. Ideal and basal variants are usually hypothetical. If the ideal variant really existed, it would be at the same time, a variant of the optimal solution. However, this situation usually does not occur and therefore any selected solution is the solution to the compromise. Compromise variant must be undominated in all tasks, which means that there is no dominating variant among decision-making variants (Ramík, 1999).

Criteria and methods of determining the values of the criteria

Alternatives are specified by using variants and the measurement of satisfaction depends on each variant. Determination of the criteria is difficult process, which requires certain knowledge of the area. The criteria used to selection of the most appropriate variants can be classified according to several aspect. Firstly it's possible to divide criteria as maximizing (income, profit) or minimizing (cost, loss) according to the level of desirable values. According to the type Secondly it is possible to divide criteria into qualitative and quantitative. These are expressed in the units of measurement.

For calculations and comparison it is usually desirable for specified criteria values y_{ij} to be normalized the unit interval, i.e.

$$x_{ij} \in [0;1] \quad (1)$$

Generally it is possible to obtain these values of the criteria from the sub-functions of the utility (value) as

$$x_{ij} = u(y_{ij}) \quad (2)$$

Utility of the criteria, which acquire the worst values is equal to 0 or close to 0, and the utility of the criteria with the best value is equal to 1.

Saaty method AHP and ANP will be used in the application part of the study, therefore the following description will be focused on these methods.

Saaty's method of pairwise comparison

The Saaty's method of weights determination of the criteria can be divided into two steps. The first step consists of a pairwise comparison when finding the preferential relations of criteria pairs. It is presented as so-called Saaty's matrix S . This matrix is symmetric with elements s_{ij} . It is possible to determine also the size of this preference expressed by a certain number of points from the selected point scale in addition to the direction of the preference of pair of criteria. Scale of relative importance (descriptors) was recommended by Saaty and it is shown in Table 2. Other values can be used to express sub-preferences. The strength of preferences is expressed in the interval $s_{i,j} \in [0;9]$. The result of this step is to obtain the right upper triangular part of the matrix size preferences (Saaty's matrix). The diagonal element have to be $s_{i,i} = 1$ and for the inverse elements (in the lower left triangular part of matrix) is true the following:

$$s_{i,j} = \frac{1}{s_{j,i}}. \quad (3)$$

The elements $s_{i,j}$ Saaty matrix are estimated shares of weights of criteria v_i and v_j , so:

$$s_{i,j} \cong \frac{v_i}{v_j}. \quad (4)$$

The scales can be obtained in the following manner:

$$\min F = \sum_i^n \sum_j^n \left(s_{i,j} - \frac{v_i}{v_j} \right)^2, \quad (5)$$

with the condition $\sum_i^n v_i = 1$.

Because of difficulty it is possible to obtain the weights using an algorithm based on the geometric average.

$$\min F = \sum_{i=1}^n \sum_{j>i}^n \left[\ln s_{i,j} - (\ln v_i - \ln v_j) \right]^2, \quad (6)$$

with the condition $\sum_i^n v_i = 1$.

The final solution is based on the geometric mean of rows (Saaty, 2010):

$$w_i = \frac{v_i}{\sum_i^N v_i} = \frac{\left[\prod_j^N s_{i,j} \right]^{\frac{1}{N}}}{\sum_i^N \left[\prod_j^N s_{i,j} \right]^{\frac{1}{N}}}, \quad (7)$$

Table 1 Recommended Point of Scale with the Descriptors by Saaty

The number of points	Descriptor
1	Element A and B are equally important
3	Element A is moderately more important than element B
5	Element A is strongly more important than element B
7	Element A is very strongly more important than element B
9	Element A is extremely more important than element B

Source: Saaty (2006), own processing

The sign of relevant evaluation is the consistency of Saaty's matrix, in other words when the elements satisfy the condition of transitivity the most. It should be emphasized that in many methods this aspect is not accounted. Consistency can be measured using the coefficient of consistency CR (Consistency Ratio). The coefficient for consistent evaluation should be $CR \leq 0,1$. Consistency ratio is calculated as following $CR = \frac{CI}{RI}$, where

$CI = \frac{\lambda_{\max} - N}{N - 1}$, (Saaty, 2010). The characteristic number of the matrix λ_{\max} can be

determined by various procedures. One option is $\lambda_{\max} = \frac{1}{N} \sum_i^N (S \cdot w)_i / w_i$, while w is a vector and $(S \cdot w)_i$ is the i -th element of the vector. Furtherly RI (Random Index) is derived from an empirical examination and reaches the following values depending on the number of criteria, see in Table 3.

Table 2 The Value RI According to the Number of Criteria

<i>N</i>	1	2	3	4	5	6	7	8	9	10
<i>RI</i>	0,00	0,00	0,52	0,89	1,11	1,25	1,35	1,40	1,45	1,49

Source: Saaty (2009), own processing

Multi-attribute methods AHP and ANP

Weights or values of criteria are in the case of decomposition tasks set by gradual decomposition from the goal, global groups of criteria, sub-groups, to the the initial sub-criteria and variants. For AHP method these linkages may be linear and for ANP method in the shape of a pyramid or nonlinear with feedbacks. Evaluation of preferences (weights) of the criteria is carried out using the Saaty's method of pairwise comparison.

Local weights (preferences) of the subgroups or indicators with regard to the specified purpose are determined by using Saaty's method of pairwise comparison. The next step is calculation of the global weights including the initial sub-weights. The sum of all sub-weights is equal to one.

In AHP method can be used analytical procedure and also method of supermatrix. In the ANP, it is possible to calculate global weights by using only the method of supermatrix (Saaty, 2010).

For analytical method AHP the indicator subgroup weights are obtained as follows, $w_{i,j} = v_i \cdot v_{i,j}$ where $w_{i,j}$ is global weight of j -th indicator and i -th group, v_i is local weight of i -th group and $v_{i,j}$ is local weight of j -th indicator and i -th group. By this way we can gradually get all the global weights of primary indicators.

The procedure for the calculation of sought weights in case of AHP and ANP **supermatrix method** can be divided into three steps:

- First step is determination of default supermatrix \bar{W} . In Fig. 1 is shown supermatrix. The local weights $v_{i,j}$ are typed to the columns inside this supermatrix \bar{W} . The weights of criteria are highlighted from $e_{2,1}$ to $e_{2,n2}$ according to the purpose (criteria) $e_{1,2}$ in Table 1.
- Subsequently the default supermatrix is transformed into the weighted supermatrix \bar{W} so, that sums of columns are equal 1.
- The last step is the calculation of limit (final) supermatrix \bar{W}^∞ . This supermatrix can be calculated like acyclical weighted matrix as following $\bar{W}^\infty = \lim_{k \rightarrow \infty} \bar{W}^k$, where \bar{W}^∞ is limit (final) supermatrix, \bar{W}^k is weighted supermatrix without existence cycle, and this supermatrix is k times amplified. Global weights are found in the first column considering the goal.

3 Determining the preferences of the indicators assessment of the level insurance market according to the AHP and ANP

We consider a task to set the weights (preferences) of evaluation indicators of the development of the insurance market to apply Saaty's method in the framework of decomposition methods AHP and ANP.

Decomposition for AHP and ANP

Decomposition is designed in two ways from the goal, categories of indicators and each indicator of the assessment of the level of the insurance market is. The first way is linear system of AHP, see Figure 1, and subsequently the second is nonlinear system ANP with typical feedbacks. The intention is to determine the weights of individual indicators of the assessment of the level of the insurance market by using AHP method and ANP method. Analytical procedure and supermatrix method can be used in the case of AHP method.

Qualitative and quantitative indicators of the assessment of the level of the insurance market are taken into account for the purposes of the article. Following indicators are included among qualitative indicators according to the subjective opinion of an expert: insurance penetration (IP) and claims frequency (CF). Following indicators are included among quantitative indicators: gross premium (GP), insurance benefit (IB), number of concluded insurance contracts (IC), average insurance premium on one insured contract (\bar{IP}), number of settled insurance claims (SIC), the average insurance benefit on one insured contract (\bar{IB}), number of employees (NE), number of commercial insurance companies (CC), concentration of the insurance market (CM).

Solution and the result for the method of supermatrix AHP and ANP

Local and global weights based on Saaty's method of paired comparison are calculated in this subchapter. At first the local weights are established and then the global weights. Global weights are calculated by both AHP and ANP method. Analytical procedure and supermatrix method were used in case of AHP. In the second case ANP, was used the only possible way and it was supermatrix method.

Table 3 The Result of AHP and ANP

Goal	Local	Groups	Global - analytical method	Global - supermatrix method	
			AHP	AHP	ANP
Qualitative	75,00 %	0			
Quantitative	25,00 %				
Insurance penetration	33,33 %	75,00 %	25,00 %	25,00 %	19,44 %
Claim frequency	66,67 %		50,00 %	50,00 %	38,89 %
Gross premium	28,36 %		7,09 %	7,09 %	11,81 %
Insurance benefit	23,24 %		5,81 %	5,81 %	9,68 %
The number of concluded insurance contracts	14,81 %		3,70 %	3,70 %	6,17 %
The average insurance premium	10,58 %		2,64 %	2,64 %	4,41 %
The number of settled insurance claims	9,31 %		2,33 %	2,33 %	3,88 %
The average insurance benefit	5,17 %		1,29 %	1,29 %	2,15 %
The number of employees	1,83 %		0,46 %	0,46 %	0,76 %
The number of commercial companies	4,02 %		1,00 %	1,00 %	1,67 %
Concentration of the insurance market	2,69 %	25,00 %	0,67 %	0,67 %	1,12 %

Σ	100,00 %	100,00 %	100,00 %	100,0 %
----------	-------------	----------	-------------	---------

Source: own processing

Determination of regression model

Multi-criterial assessment is a subjective method, where the preferences are divided into the subjective feelings of decision-maker. Final order of indicators assessment of the insurance market level using AHP and ANP method was verified by regression analysis.

Using regression analysis it is possible to study not only the relationship between dependent and independent variable, but also to find out the strength of this relationship. In this part the indicators were divided into the same two groups qualitative and quantitative, where subsequently for each group the regression model is created. The model was estimated without constant, because of more accurate results.

To the group of qualitative indicators have been included insurance penetration and claim frequency. In this step it is necessary to choose dependent variable. As the most suitable indicator appears claim frequency. Independent variable remains insurance penetration. The results of model estimation it is advisable to test by F-test. The model was verified using F-test, which is used for verification of statistical significance of the model as a whole. According to the results of this test, see Table 5, the model is statistically significant.

Table 4 The Result of F-test

ANOVA ^{a,b}						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4,973	1	4,973	637,809	,000 ^c
	Residual	,125	16	,008		
	Total	5.097 ^d	17			

Source: own processing

In the case of the quantitative indicators the selection process was more complicated. The quantitative indicators is nine. As dependent variable was selected indicator of gross premium and other indicators are independent variables. Dependent variable was chosen based on their statistical significance.

In modelling process and the gradual inclusion of explanatory variables can be used three ways. First option is called forward stepwise, it is the upward selection, when it starts to estimate empty model and gradually comes to adding statistically significant variables. The second opposite way is called backward elimination, where all statistically significant variables are included and gradually exclude insignificant variables. The third and last way is, that first occurs to estimate coefficients by one-dimensional analysis and then the suitable variables are included in model. For the purposes of this paper the second way is chosen.

In this part the regression model was estimated with dependent variable gross premium and others explanatory variables. Statistical significance was verified by F-test, the same like in previous model. According to the results of this test, it is possible to confirm the statistical significance of the model as a whole. The results of F-test, see Table 6.

Table 5 The Result of F-test

ANOVA ^{a,b}						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	277737851214752 832,000	8	347172314018 44104,000	21740, 991	,000 _c
	Residual	14371704054231, 875	9	159685600602 5.764		

Total	277752222918807	1
	072,000 ^d	7

a. Dependent Variable: GP

Source: own processing

In the framework of the evaluation the materiality of indicators was taken into account the value of significance, which is determined by the statistical significance of each variable. The value of significance should be maximum around 0,05 for a significance level 95 %. When the value is higher than 0,05, the indicator is considered statistically insignificant and should be excluded from the model.

Table 6 Final Regression Model

		Coefficients^{a,b}			t	Sig.
Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta		
1	IB	1,806	,088	,999	20,519	,000
	IC	5,211	,227	,958	22,925	,000
	ØIP	25102,442	1388,655	1,055	18,077	,000
	SIC	-56,205	2,776	-1,074	-20,248	,000
	ØIB	-4216,859	250,568	-,931	-16,829	,000

Source: own processing

The final order of variables was created by correlation matrix of these independent variables and response variable. The final order of the indicators was determined on the basis results of the correlation matrix. Correlation analysis is shown on Table 7.

Table 7 Correlation matrix of variables

		Correlations					
		GP	IB	IC	SIC	ØIP	ØIB
GP	Pearson Correlation	1	,882**	,976**	,784**	,841**	,871**
	Sig. (2-tailed)		,000	,000	,000	,000	,000
	N	17	17	17	17	17	17
IB	Pearson Correlation	,882**	1	,906**	,901**	,623**	,950**
	Sig. (2-tailed)	,000		,000	,000	,008	,000
	N	17	17	17	17	17	17
IC	Pearson Correlation	,976**	,906**	1	,789**	,708**	,895**
	Sig. (2-tailed)	,000	,000		,000	,001	,000
	N	17	17	17	17	17	17
SIC	Pearson Correlation	,784**	,901**	,789**	1	,589*	,725**
	Sig. (2-tailed)	,000	,000	,000		,013	,001
	N	17	17	17	17	17	17
ØIP	Pearson Correlation	,841**	,623**	,708**	,589*	1	,624**
	Sig. (2-tailed)	,000	,008	,001	,013		,007
	N	17	17	17	17	17	17
ØIB	Pearson Correlation	,871**	,950**	,895**	,725**	,624**	1
	Sig. (2-tailed)	,000	,000	,000	,001	,007	
	N	17	17	17	17	17	17

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Source: own processing

Based on the results of the regression analysis, it is clear that the order of qualitative indicators is the same as in the case of multicriterial decision making, but the order of quantitative indicators is slightly different.

Table 8 Final Order of the Key Assessment Indicators

Indicators	Order
Claims frequency	1.
Insurance penetration	2.
Gross premium	3.
The number of concluded insurance contracts	4.
Insurance benefit	5.
The average insurance benefit	6.
The average insurance premium	7.
The number of settled insurance claims	8.
Concentration of the insurance market	9.
The number of employees	10.
The number of commercial insurance companies	11.

Source: own processing

4 Conclusions

The aim of this paper was to determine the preferences of indicators of evaluation of the level of insurance market using multi-attribute methods AHP and ANP on the basis of Saaty's method of paired comparison. Methods including multi-attribute decomposition AHP and ANP on the basis of Saaty's method of paired comparison were described. Subsequently analytical method and supermatrix method AHP were applied on the example of determination of preferences of indicators assessment of the level of insurance market. It was found that both approaches AHP and ANP lead to the same results and at the same time, that the results obtained on the basis of linear methods of AHP and non-linear method ANP differ significantly.

Subsequently, the final order was verified by regression model. In the framework of the regression analysis were estimated of total two models. At first was estimated the model with qualitative variables, where the dependent variable was claim frequency. The second regression model was estimated using quantitative indicators, where dependent variable was gross premium. The results showed that the final order according to AHP and regression analysis for qualitative indicators was the same, but the order of quantitative indicators were slightly different.

Acknowledgments

This paper was supported by the SGS Project VŠB – TU Ostrava SP2018/154 "Finanční rozhodování podniků a finančních institucí za rizika".

References

- Fotr, J., Dědina, J., Hrušková, H. (2010). *Manažerské rozhodování*. 2. aktualiz. vyd. Praha: Ekopress.
- Hasoňová, D. (2018) *Hodnocení úrovně pojistného trhu aplikací vícekriteriálních dekompozičních metod*. Ostrava: VSB – Technická univerzita Ostrava. Diploma Thesis.
- Ramík, J. (1999). *Vícekriteriální rozhodování – analytický hierarchický proces (AHP)*. 1. vyd. Karviná: Slezská univerzita v Opavě.
- Saaty, T. L. (2012). *Decision making form leaders: the analytic hierarchy process for decisions in a complex world*. 3rd rev. ed. Pittsburgh: RWS Publications.

Saaty, T. L. (2010). *Mathematical principles of decision making: generalization of the analytic network process to neural firing and synthesis*. 1st ed. Pittsburgh: RWS Publications.

Saaty, T. L. (2009). *Theory and applications of the analytic network process: decision making with benefits, opportunities, costs, and risks*. 3rd ed. Pittsburgh: RWS Publications.

Zmeškal, Z., Dluhošová, D., Tichý T. (2013). *Finanční modely: koncepty, metody, aplikace*. 3., přeprac. a rozš. vyd. Praha: Ekopress, 2013. ISBN 978-80-86929-91-0.

Fractal Dimension vs. Non-fractal Risk Measures – Correlation Analysis

Rafał Buła

University of Economics in Katowice
Faculty of Finance and Insurance, Department of Investment and Real Estate
1 Maja 50, 40-287 Katowice, Poland
E-mail: rafal.bula@ue.katowice.pl

Abstract: *In the presented paper the relationships between fractal dimension and chosen non-fractal measures of risk are analyzed and discussed. The main objective of the study is to reveal the nature of these dependencies. Moreover, the article is aimed at analyzing whether the abovementioned relations are stable independently of the length of investment horizon considered and of period chosen. In the article prices of shares listed on the Warsaw Stock Exchange are studied using methods of correlation analysis (various correlation coefficients). Calculated values and results of various statistical tests enable to draw a few conclusions. First of all, it must be noticed that the main scientific hypothesis in case of risk measures like standard deviation ought to be rejected, while e.g. for the omega or Farinelli-Tibiletti ratio we are unable to do it. Moreover, it must be concluded that this regularity is valid independently of the length of the investment horizon and analyzed period of time.*

Keywords: fractal dimension, risk measurement, correlation analysis

JEL codes: G17

1 Introduction

This study is devoted to the quantification of investment risk with particular emphasis on the relationships between risk measures. The inspiration for undertaking the presented research was the observation that, until now, the problem of existing relationships between the fractal dimension and other measures used in the quantification of investment risk has not been properly addressed. What's more, there are virtually no studies focusing on the identified problem. The analysis of the literature justifies the conclusion that the outlined problems are relatively poorly examined.

Among various risk measures, the fractal dimension (*box-counting dimension*) should be considered as particularly interesting. It ought to be noted that this measure has not been proposed *ad hoc*, but its use is a logical consequence of attempts to replace the existing paradigm in finance science based on the use of Brownian geometric motion to modelling asset prices with the fractal market concept. As the basic idea behind this concept is to describe the observed prices by self-similar stochastic processes, the natural consequence of its adoption is the use of adequate instruments to allow for the analysis of the nature of this self-affinity. Thus, the fractal dimension is not so much gaining the right to exist in the world of self-similar trajectories of prices or rates of return, but rather becomes indispensable for the correct measurement of investment risk. Its use is therefore justified on theoretical grounds.

The main purpose of the presented study is to analyze the correlation relationship between the possibly broad spectrum of measures used in the quantification of investment risk and the fractal dimension in relation to shares listed on the Warsaw Stock Exchange.

In addition, the goal of the paper is to examine whether the length of the investment horizon for which risk measures are estimated influences the relationships between them and the fractal dimension.

The third goal of the study is to analyze the time consistency of previously identified relations.

The main research hypothesis is that there are no significant relationships between the fractal dimension and the non-fractal measures of investment risk, regardless of the length of the investment horizon for which they are calculated.

As part of the second research hypothesis, it was supposed that the postulated relations are relatively stable over time.

While conducting the research, the author adopted appropriate statistical methods. The obtained results allowed for a comparative analysis in relation to the strength of the correlation relationship between individual risk measures and the fractal dimension as well as its stability over time. The studies were based on share prices originating from the Warsaw Stock Exchange. All quotations used come from the stooq.com website. The author used the MS Excel spreadsheet and the Visual Basic for Applications language for the calculations.

The present state of knowledge

Conducting the literature research, the author noticed that the problems raised in this study are virtually absent in the literature. Although the concept of a fractal dimension and a new paradigm based on the theory of the fractal market are present in the scientific discourse (Mandelbrot and Hudson, 2004), the issues of relationships between investment risk measures and the fractal dimension remain unexplored.

In one of the first studies devoted to fractal empirical analysis of quotations from the Polish stock market, Zwolankowska (2001) used the quotations of 21 companies and the WIG index levels in the years 1994-1998. She estimated both standard deviations of the logarithmic return rates and the fractal dimension of the price series. The results for the same group of companies, however, referring to the logarithmic and cumulative logarithmic rates of return, were presented in one of her papers (Zwolankowska, 1999). The summary results for the entire period 1994-1998 are presented in the chart below (Figure 1).

As Zwolankowska concludes, in the light of the presented data, it is difficult to postulate the existence of significant relationships between the fractal dimension and standard deviation. This statement, however, was not supported by any in-depth analysis or statistical test, but only by a subjective assessment of ordering the indicated values.

Analogous considerations regarding stock exchange indices published by the Warsaw Stock Exchange were carried out by Orzeszko (2010). It should be noted that although he calculated the standard deviations for the rates of return (though he did not specify them), the fractal dimension (using the Zwolankowska method) – for index levels. The results are collected in the chart below (Figure 1).

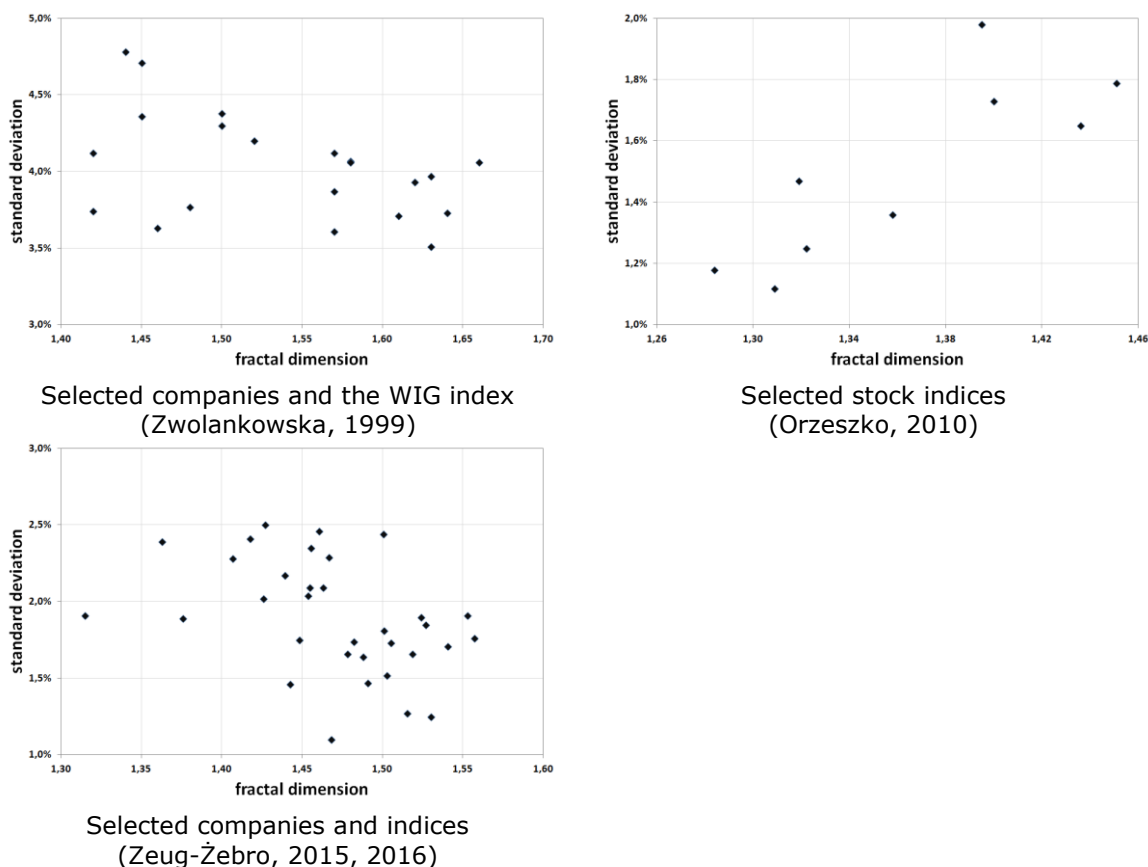
On the basis of the obtained results, Orzeszko formulates the conclusion that the fractal dimension and standard deviation lead to the ordering of the examined indices in a similar way, and then analyzes them in sub-periods. It should be noted that also in this case no formalized statistical inference methods were used, and the sample is very small.

A similar analysis was presented by Zeug-Żebro (2015, 2016, 2017) and Miśkiewicz-Nawrocka (2016) with reference to the standard deviation and taxonomic measure of investment attractiveness based on the Hellwig method (1968). The results obtained in the graphical form are summarized below (Figure 1).

In further analyzes, the Authors do not analyze the relationship between the fractal dimension and other measures in a formalized way (because it is not the purpose of their work), but adopt the subjective assessment of rankings prepared for the presented companies. However, they point out to the small grounds for identifying possible dependencies.

As indicated, there are no in-depth analyzes of the relationship between commonly used investment risk measures and the fractal dimension. For this reason, it was considered appropriate to carry them out, as discussed below.

Figure 1 Fractal Dimension and Standard Deviation
Estimated for Various Companies and Indices



Source: Own elaboration based on Zwolankowska (1999), Orzeszko (2010), Zeug-Żebro (2015, 2016)

2 Methodology and Data

An important issue faced by the author was selection of quantities from among the existing risk measures which can be adopted in further research. While making the choice, several criteria were adopted. In the first place, all measures taking into account in their structure apart from the risk also the level of expected income, were excluded from further considerations. Due to the fact that the goal of the study is to analyze dependencies between the fractal dimension and measures reflecting the riskiness of investments only, using the quantities comparing the income and risk does not seem justified (Bacon, 2013).

Moreover, when making a choice, special attention was paid to measures of a universal nature, the use of which involves the adoption of relatively few additional assumptions. In particular, attempts were made to avoid measures requiring *a priori* assumption of the type of probability distribution or the stochastic process describing the observed rates of return.

In addition, the function measures were removed from the examined quantities. For this reason, the analyzed set did not include variance or semi-variance of the rate of return, or, for example, the kappa coefficient (as functionally related to the omega coefficient) (Frey, 2017, Michalska and Kopańska-Bródka, 2015).

Due to the fact that the paper analyses the quotations of stock prices, the measures specific to fixed-income instruments (such as *duration*) or derivative instruments (such as *the Greeks*) have been eliminated.

In further considerations, the analyzed risk measures have been appropriately grouped due to the similarities resulting either from their construction, or due to the use of certain

probability distribution properties to measure them. The author finally identified 8 groups of risk measures by the way of a subjective assessment and they are compiled in Table 1.

Table 1 An Adopted Division of Selected Investment Risk Measures

Group	Measure	Group	Measure	Group	Measure
A	R	C	$VaR_{0,95}$	F	$Loss\ frac.$
	s		$GaR_{0,95}$		$BR(0)$
	d		$DVaR_{0,95;0,95}$		$BR(\mu)$
	d_p		$CVaR_{0,95}$		g_1
	Q		$CGaR_{0,95}$	G	$\Omega(0)$
	Δ'		$R_{0,95;0,95}$		$FT_2^2(0)$
	Δ		\bar{D}		$FT_2^2(\mu)$
	g_2		D_{lar}		$\dim_B(X)$
B	$LPM_2(R, 0)$	D	D_{max}	H	
	$LPM_2(R, \mu)$		$DaR_{0,95}$		
	$LPM_1(R, 0)$		DD		
	$LPM_1(R, \mu)$		UI		
	$UPM_2(R, 0)$		PI		
	$UPM_2(R, \mu)$		LR		
	$UPM_1(R, 0)$		PR		
	$UPM_1(R, \mu)$		β_{Sharpe}		
	$LSD_2(R, 0)$	E	$\beta_{+Sharpe}$		
	$LSD_1(R, 0)$		$\beta_{-Sharpe}$		
	$GSD_2(R, 0)$		BTR_{Sharpe}		
	$GSD_1(R, 0)$		β_{CAPM}		
	$LSD_2(R, \mu)$		β_{+CAPM}		
	$LSD_1(R, \mu)$		β_{-CAPM}		
	$GSD_2(R, \mu)$		BTR_{CAPM}		
	$GSD_1(R, \mu)$		$Syst.risk$		
			$Spec.risk$		

Source: own elaboration

The time series of closing prices for shares listed on the Warsaw Stock Exchange were analyzed based on the quotations provided by the stooq.com website. One of the initial problems was to determine the set of companies for the analysis and the length of time series used in further research. The only assumption that was adopted prior to the initial data analysis was the premise that the time series should represent the same period, so that the comparable risk measures could be obtained. In addition, it was considered desirable to have series with a similar number of observations.

Based on the analysis of the data obtained, it was decided to qualify for further research companies for which the average number of quotations in the year was not less than 227 (with an average of 252 quotations in a year), and the maximum interval in days between quotations was no more than 21 days. The adoption of less strict criteria does not lead to a significant increase in the number of surveyed companies, while the acceptance of more

strict ones results in a drastic reduction in the number of entities analyzed. Finally, in further research, the quotations of 58 companies (1 January 1998 – 31 October 2017, investment horizon length varied from 1 to 252 trading days), 87 companies (1 January 2003 – 31 October 2007, 1 to 189 trading days) and 207 companies (1 January 2008 – 31 October 2017, 1 to 126 days) were used.

In the next step, the logarithmic and cumulative logarithmic rates of return for each investment horizon were calculated. If quotes of a particular company were not available for a given day, then they were replaced with the last available quote. Next, previously indicated risk measures were calculated for each investment horizon. As a result, in relation to the period from 1 January 1998 to 31 October 2017, 14,364 sequences of risk measures were available (each with 58 terms), for the period from 1 January 2003 to 31 October 2007 – 10,773 (each with 87 terms), while for the period from 1 January 2008 to 31 October 2017 – 7182 (each with 207 terms).

When estimating the measures related to the Sharpe diagonal model or CAPM, it was necessary to select a market factor and an instrument playing the role of a risk-free instrument. In the first case, the broad market index was used, which is the Warsaw Stock Exchange Index, while in the latter, the WIBID TN rate (transformed into a logarithmic rate) was used.

The main purpose of the paper is to analyze the relationships between the non-fractal measures of risk and the fractal dimension. For this reason, the focus has been on methods enabling the study of the strength and direction of potential dependencies. To this end, standard correlation analysis methods were employed. Different correlation coefficients were used, i.e. Pearson correlation coefficient, Spearman's correlation coefficient, Kendall's tau and correlation ratio (Domański, 1990), (Kendall, 1962). Due to the possibility of statistically insignificant correlations, in the next step, the hypothesis of the null correlation coefficient between individual risk measures was verified with the use of appropriate statistical tests. The level of significance was assumed 0.05 in all the tests.

3 Results and Discussion

First of all, all the presented risk measures were calculated. If these measures were defined in relation to a certain threshold value, such as partial moments, the zero and the mean value were taken as the limit value. Because in addition to the relationship between the fractal dimension and the level of classical risk measures, the relationship between the fractal dimension and their fluctuations in time is also significant, additionally available for different time intervals, the measures were scaled by dividing them by the appropriate risk measure calculated for a time interval equal to one session. Both primary and scaled data were analyzed.

In the next step, correlation coefficients were calculated and the null hypothesis was verified. Below, a graphic illustration for the investment horizon length of 1 session is presented (Figure 2).

Since the analysis of the correlations between all the measures used and the fractal dimension would not be possible due to the limited size of this paper, it was decided to limit it to presenting a few of the most important ones. Guided by the importance and common use of a given quantity, it was decided to analyze the relationship between the fractal dimension and: standard deviation, standard semi-deviation (relative to zero), value-at-risk, ulcer index, conditional value-at-risk, largest individual drawdown as well as omega, beta coefficient for the classical Sharpe model, Farinelli-Tibiletti ratio to zero and bias ratio (Figure 3).

Figure 2 Correlation Coefficients and Correlation Ratio Between Selected Investment Risk Measures for 1-Session Logarithmic Return Rates on Shares of Selected Companies in the Period from 1 January 1998 to 31 October 2017

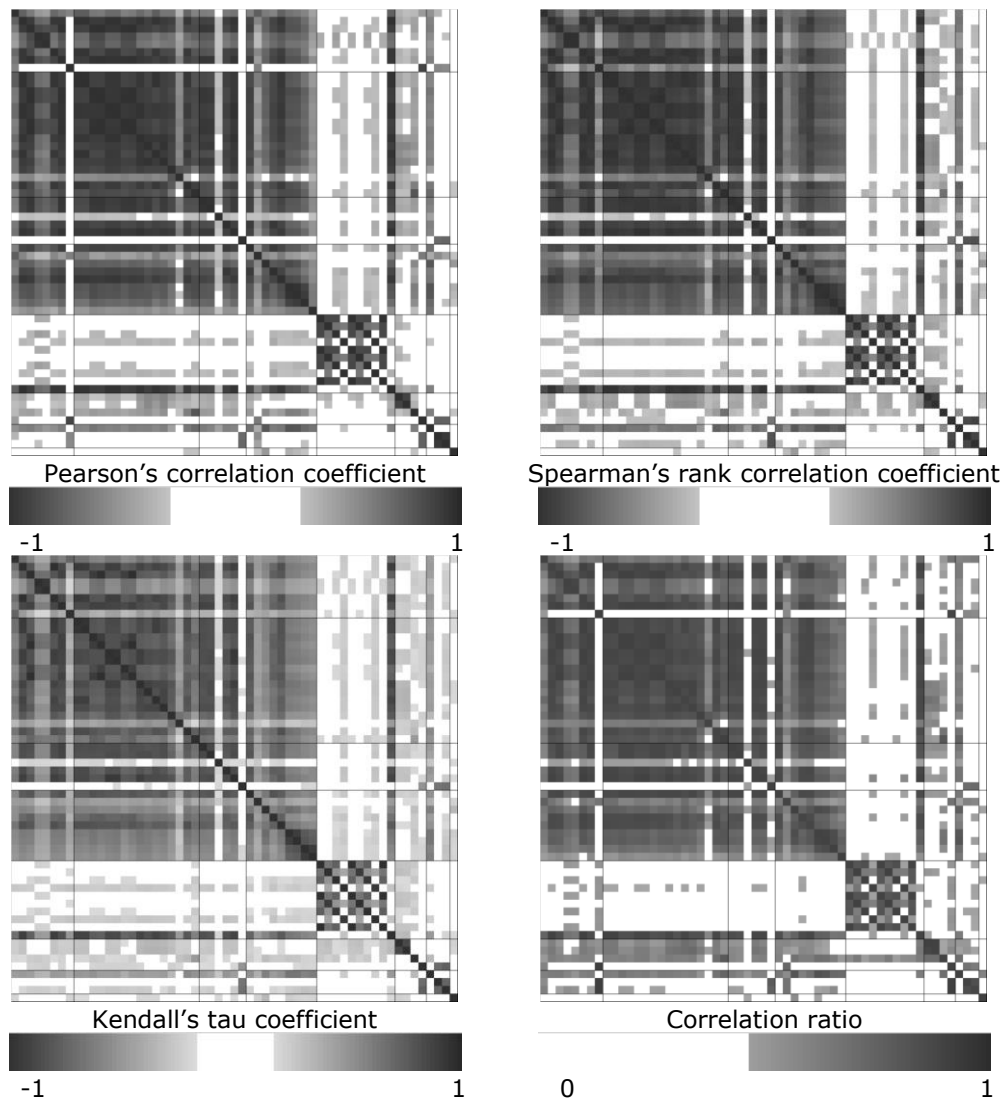
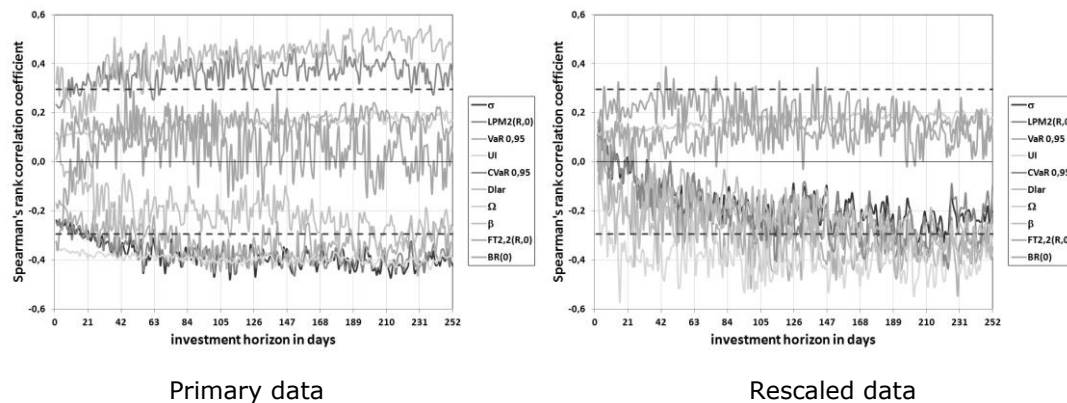


Figure 3 Spearman's Rank Correlation Coefficient Between the Fractal Dimension and the Selected Risk Measures in the Period from 1 January 1998 to 31 October 2017



When analyzing the calculated values, several regularities can be noticed. Firstly, the quotient measures (bias ratio, omega, Farinelli-Tibiletti ratio) show little or no relation to the fractal dimension, both before and after the re-scaling. Secondly, the measures referring to extreme events (largest drawdown, conditional value at risk) are relatively strongly correlated with the fractal dimension in terms of their absolute level, while the scaled ones show rather negative relationships. Thirdly, classical volatility and stress measures (standard deviation, second partial moment, value at risk) are negatively correlated with the fractal dimension, both at their relative and absolute levels. A similar trend is shown by the beta coefficient and ulcer index.

4 Conclusions

The considerations carried out and analysis of empirical data give some ground to formulate a number of conclusions.

Examining the relationship between the fractal dimension and other risk measures, it has been shown that in relation to the shares listed on the Warsaw Stock Exchange, the nature of these dependencies varies depending on the measure chosen. In the case of measures that can be described as measures comparing the shapes of the probability distribution with respect to a certain cut-off level (such as bias ratio, omega or Farinelli-Tibiletti ratio), the analysis shows that the fractal dimension is not linked with these measures. Lack of dependence is revealed in both static and dynamic aspects. Thus, irrespective of the length of the considered investment horizon, the information provided by these measures is different, and therefore simultaneous use of the fractal dimension and indicated quantities is expedient. The obtained result is also a natural consequence of the essence of the fractal dimension, which refers to the variability rather than the shape of the distribution describing the prices or rates of return. It should be noted that the main hypothesis was confirmed with reference to the above-mentioned measures.

With respect to volatility and stress measures, such as standard deviation, standard semi-deviation, but also value-at-risk or ulcer index between the fractal dimension and the mentioned values, dependencies were found both in relation to their absolute and relative level – in both cases of negative nature. At the same time, the indicated relationships seem to get stronger along with the extension of the investment horizon, which is an additional confirmation of the hypothesis made by the author (Buła, 2013), (Buła and Pera, 2015), (Buła, 2017) namely that for short periods the increase in the fractal dimension means an increase in the risk level *ceteris paribus*, while for the lengthening investment horizons – its decrease – *ceteris paribus*. This study confirms the said hypothesis not only for a static but also a dynamic approach. Thus, for the indicated measures, the main research hypothesis should be rejected.

For risk measures relating to extreme events, i.e. conditional value at risk or the largest drawdown, the conclusions are identical to the conclusions for the previously described group. The only difference is due to the fact that in the case of the indicated measures, their fall is considered to be equivalent to increasing the riskiness of investments, thus the direction of dependence is reversed (i.e. positive). The essence of things remains the same, which again confirms the hypothesis, but for a completely different set of risk measures.

Having presented the nature of the relationship between individual risk measures and the fractal dimension, it should be noted that despite some variability resulting either from the number of companies surveyed or the number of available quotations, the relations are relatively stable over time, as demonstrated by comparative analysis carried out for the analyzed risk measures calculated for three periods: twenty-year, fifteen-year and ten-year. It is true that the analyzed periods were not separable, but in the author's view, the need to have an adequate set of quotations justifies the decision made. Thus, confirmation of the second research hypothesis was obtained. At the same time, it can be stated that the objectives set out by the author have been fully attained.

References

- Bacon, C. (2013). *Practical Risk-Adjusted Performance Measurement*. Chichester: John Wiley & Sons.
- Buła, R. (2013). Ryzyko inwestycji a wymiar fraktalny. *Studia Ekonomiczne*, vol. 155, pp. 450-466.
- Buła, R., Pera, K. (2015). Применение концепции фрактальной размерности для оценки инвестиционного риска на финансовых рынках. In: Белозеров, С. А., ed., *Международный экономический симпозиум*. Санкт-Петербург: Скифия-принт, pp. 217-235.
- Buła, R. (2017). Analiza wymiaru fraktalnego spółek notowanych na Giełdzie Papierów Wartościowych w Warszawie – aspekty metodyczne. *Nauki o Finansach*, vol. 30, pp. 9-27.
- Domański, C. (1990). *Testy statystyczne*. Warszawa: PWE.
- Frey, R. (2017). *On the Ω -Ratio*. Retrieved from: <http://www.ams.sunysb.edu/~frey/Research/Research/OmegaRatio/OmegaRatio.pdf>.
- Hellwig, Z. (1968). Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom ich rozwoju oraz zasoby i strukturę wykwalifikowanych kadr. *Przegląd Statystyczny*, vol. 4, pp. 307-327.
- Kendall, M. (1962). *Rank Correlation Methods*, 3rd ed. London: Charles Griffin & Company.
- Mandelbrot, B., Hudson, R. (2004). *The (Mis)Behavior of Markets*. New York: Basic Books.
- Michalska, E., Kopańska-Bródka, D. (2015). The omega function for continuous distribution. In: Martiněik, D., Ircingová, J., Janeček, P., ed., *Mathematical Methods in Economics 2015*. Plzeň: University of West Bohemia, pp. 543-548.
- Miśkiewicz-Nawrocka, M. (2016). Zastosowanie wykładnika Hursta do wyznaczania portfeli optymalnych. *Studia Ekonomiczne*, vol. 265, pp. 38-51.
- Orzeszko, W. (2010). Wymiar fraktalny szeregów czasowych a ryzyko inwestowania. *Acta Universitatis Nicolai Copernici*, vol. 397, pp. 57-70.
- Zeug-Żebro, K. (2015). Zastosowanie wybranych metod szacowania wymiaru fraktalnego do oceny poziomu ryzyka finansowych szeregów czasowych. *Studia Ekonomiczne*, vol. 227, pp. 109-124.
- Zeug-Żebro, K. (2016). Badanie wpływu zastosowania wymiaru fraktalnego na konstrukcję portfela optymalnego. *Studia Ekonomiczne*, vol. 265, pp. 120-132.
- Zeug-Żebro, K. (2017). Analiza wpływu zastosowania redukcji poziomu szumu losowego na poziom ryzyka inwestycyjnego. *Studia Ekonomiczne*, vol. 335, pp. 77-90.
- Zwolankowska, M. (1999). Wykorzystanie wymiaru fraktalnego w ocenie ryzyka inwestycji giełdowych. In: Trzaskalik, T., ed., *Modelowanie preferencji a ryzyko '99*. Katowice: Wyd. UE.
- Zwolankowska, M. (2001). *Fraktalna geometria polskiego rynku akcji*. Szczecin: WN US.

Measuring Efficiency in Clinical Departments Using the DEA Approach - A Case of the Polish Hospital

Małgorzata Cygańska¹, Magdalena Kludacz-Alessandri², Dimitrios Syrrakos³

¹ University of Warmia and Mazury in Olsztyn
The Faculty of Economics, Department of Finance and Banking
Oczapowskiego 4, 10-719 Olsztyn, Poland
E-mail: m.cyganska@uwm.edu.pl

² Warsaw University of Technology
The College of Economics and Social Sciences
Łukasiewicza 17, 09-400 Płock, Poland
E-mail: Magdalena.Kludacz@pw.edu.pl

³ Manchester Metropolitan University
Business School Building
All Saints
Manchester M15 6BH
United Kingdom
E-mail: D.Syrrakos@mmu.ac.uk

Abstract: *Evaluating hospitals' efficiency in Poland is vital considering in the light of limited public funds dedicated to healthcare. As such, employing a mechanism capable of identifying inefficiencies by hospital administrators would be conducive to the quality of the services delivered. The aim of this article is to ascertain the merits of efficiency measures as instruments of monitoring and distributing resources, by focusing on the clinical departments of provincial specialist hospital in Olsztyn in Poland. The hospital under perspective, provides diagnostics, therapy, care, specialist advice, education prevention and health promotion. Efficiency of hospital departments was measured using Data Envelopment Analysis (DEA). The distribution of efficiency and the ranking of clinical departments was compared across surgical and non-surgical departments' profile. Input and output data was collected from the hospital database for 19 578 patients admitted to 14 departments between January and June 2017. The research shows that only 5 clinical departments (35.71%) run efficiently. These were the Departments of Hematology, Gynecology, Vascular Surgery, Rehabilitation and Ophthalmology. Most of them provide surgical procedures. The least efficient was the Department of Transplantology and General Surgery. The paper's findings could potentially inform manager's choices in relation to increasing efficiency. Since hospital managers have more control over their inputs, they may devote more attention to the examination of total inefficiencies generated by excessive input usage.*

Keywords: *clinical department efficiency, data envelopment analysis (DEA), input, output*
JEL codes: *M41, C67, I19*

1 Introduction

Hospital health care occupies a special place in all health care systems, and it is the biggest consumer of health care financial resources in Poland and in most other developed countries. For instance, a considerable share (16–48%) of total health expenditure in OECD countries is devoted to the hospital sector. Hospitals are increasingly under pressure to improve their efficiency of operations, as well as improving the quality of the health services provided. This is due to the growing expectations of patients and the huge costs caused by demographic changes. On the other hand, the health care sector is characterized by limited inflow of financial resources whose rules of spending are subject to detailed regulations and supervision. Decision makers are increasingly presented with the challenge of reconciling the growing demand for health care services on the one hand, and the limited financial resources on the other (Nakagawa et al., 2011).

Public institutions' activities are not subject to normal competition rules and are not profit oriented. As governments' subsidies to public hospitals have been decreasing, more efficient use of available resources becomes essential for hospital administrators. As a result, the distribution of financial resources should be linked to the effectiveness of hospitals and other entities providing medical services (Grzesiak and Wyróżbka, 2014).

Efficiency is amongst the most pressing issues in health care and hospital efficiency is one of the key indicators of hospital performance. Efficiency is concerned with the relation between resource inputs (e.g. costs, in the form of labour, capital, or equipment) and either intermediate outputs (e.g. numbers of treated patients, waiting time) or final health outcomes (e.g. life years gained, quality adjusted life years - QALYs) (Palmer and Torgerson, 1999). From a measurement perspective, efficiency can be divided into technical and economic efficiency. In the theory of production and costs of organization, the third aspect of efficiency is also often used - allocative efficiency. Quite often when defining efficiency the authors make only the distinction between technical and allocative efficiency measures, which together comprises the overall (economic) efficiency, and scale efficiency (Varabyova and Schreyögg, 2013).

Economic efficiency implies an economic state in which every resource is optimally allocated to serve each individual or entity in the best possible way while minimizing waste and inefficiency. In health care, economic efficiency implies that society makes choices which maximize the health outcomes gained from the resources allocated to healthcare. Inefficiency means that resources could be re-allocated in a way that would increase the health outcomes produced. Technical efficiency refers to the physical relation between resources (input) and health outcomes (output). It refers to the ability to obtain the maximum possible improvement in outcome (maximum output) from a given set of resources (inputs) or to minimize input factors to achieve a given outcome. (Ludwig, 2008). This paper analyzes only technical efficiency.

In practice, various methods can be used to precisely determine which hospitals and their departments are more active and effective, and to indicate the factors affecting this efficiency. The methods of measuring effectiveness can be broadly divided into three basic groups (Suchacka, 2009):

- ratio analysis - it is a quantitative analysis used to evaluate various aspects of an operating and financial performance,
- parametric methods - e.g. Stochastic Frontier Analysis (SFA), Thick Frontier Approach (TFA), Distribution Free Approach (DFA),
- non-parametric methods - Free Disposal Hull analysis (FDH), Data Envelopment Analysis (DEA).

Nonparametric methods are used to measure the technical efficiency of hospitals and enable the analysis of inputs and results (Vincova, 2005). Data envelopment analysis (DEA) is receiving increasing importance as a tool for evaluating efficiency and improving the performance of manufacturing and service operations for a wide variety of industries and institutions. In recent years, DEA has gained great popularity in healthcare branches and it has been extensively applied in productivity measurement, performance evaluation and benchmarking of organizational units, like hospitals, which use numerous resources to produce multiple products (Cook et al., 2014). There are many contributions in the literature regarding DEA effectiveness in health care sector. The scale of conducted research differs, e.g. research on the efficiency of hospitals within larger units (e.g. administrative) or research on health systems of individual countries. Areas of DEA application in health care sector also include physicians, nursing homes, and health maintenance organizations.

An application of DEA in health care offers several advantages over other techniques. Comparison of three performance methodologies (a ratio analysis, regression analysis, and data envelopment analysis) showed that DEA is superior to other methods because it incorporates an optimizing principle rather than an averaging principle (Nyhan et al., 2000). The DEA approach offers also other advantages over the other ratio methods, such as:

- it combines multiple ratios into a single ratio of productive efficiency;
- it outperforms other methods in identifying sources and amounts of inefficiencies;
- it compares each DMU (e.g. hospitals) to its peers and identifies benchmark facilities for inefficient hospitals (Chilingerian, 1990).

Data envelopment analysis (DEA) is a linear-programming-based technique, established for measuring the relative efficiencies of units delivering similar services, which are called decision making units (DMUs). The input and output data of the units under analysis show what is achieved with the technology presently available. The aim of the DEA is to establish the relative efficiency of each DMU within a sample and identify which units operate efficiently and therefore belong to the efficient frontier, and which of them operate inefficiently. Increasing efficiency of inefficient DMUs is possible by making appropriate adjustments in their outputs or inputs (Ancarani et al., 2009). DEA has the advantage of being able to deal with multidimensional nature of input/output variables and measures efficiency for when multiple outputs and inputs are simultaneously present and provides a single (relative to best) productivity index that is generally referred to as relative efficiency.

This paper employs the envelopment analysis (DEA) as a tool for evaluating the relative technical efficiency of hospital wards at the Polish public hospital in Olsztyn. This method provides a single measure of efficiency of each ward and allows hospital managers to make comparisons of hospital departments using the same set of criteria (inputs and outputs).

2 Methodology and Data

This section introduces the key principles of the DEA as a productivity analysis tool for a hospital. Single efficiency scores have been calculated and compared using hospital wards as decision-making units (DMU). To the authors' knowledge the calculation of ward-specific efficiency scores is not often the unit of non-parametric efficiency analysis, and thus the studies of efficiency within the hospitals, are very limited. The majority of studies make use of the hospital as the decision-making unit, rather than the hospital ward (e.g. Steinman and Zweifel, 2003). The rationale for not using hospital wards as the preferred units of analysis is that intermediate outputs (e.g. discharges and patient days) and inputs (e.g. medical equipment) are very heterogeneous across the departments representing various medical fields. This implies that differences among wards as DMUs due to specialty may be confused with differences in technical efficiency (Ancarani et al., 2009). On the other hand, the study of hospital wards' efficiency could shed further light on managerial and organizational aspects of the central management policy concerning capacity. The organizational structure of hospital may vary, but departments serve as the core units of a hospital. The decisions made in the clinical departments will determine the use of resources. This justifies viewing each clinical department as a single decision making unit (DMU).

This model provides the efficiency score in the presence of multiple input and output factors defined as:

$$Efficiency = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}} \quad (1)$$

Assuming that there are n DMUs, each with m inputs and s outputs, the relative efficiency score of a test DMU p is obtained by solving the following model proposed by Charnes et al. (1978):

$$\max \frac{\sum_{k=1}^s v_k y_{kp}}{\sum_{j=1}^m u_j x_{jp}} \quad (2)$$

$$s.t. \frac{\sum_{k=1}^s v_k y_{ki}}{\sum_{j=1}^m u_j x_{ji}} \leq 1 \quad \forall_i \quad (3)$$

$$v_k u_j \geq 0 \quad \forall_{k,j}$$

where

$k = 1$ to s ,

$j = 1$ to m ,

$i = 1$ to n ,

y_{ki} = amount of output k produced by DMU i ,
 x_{ji} = amount of input j utilized by DMU i ,
 v_k = weight given to output k ,
 u_j = weight given to input j .

The fractional program shown as (2, 3) can be converted to a linear program as shown in (4,5). For more details on model development see Charnes et al. (1978).

$$\text{ax } \sum_{k=1}^s v_k y_{kp} \quad (4)$$

$$\text{s.t. } \sum_{j=1}^m u_j x_{jp} = 1 \quad (5)$$

$$\sum_{k=1}^s v_k y_{ki} - \sum_{j=1}^m u_j x_{ji} \leq 0 \quad \forall i$$

$$v_k, u_j \geq 0 \quad \forall k, j$$

The above problem is run n times in identifying the relative efficiency scores of all the DMUs. Each DMU selects input and output weights that maximize its efficiency score. In general, a DMU is considered to be efficient if it obtains a score of 1, and a score of less than 1 implies that it is inefficient. We used Data Envelopment Analysis Program (version 2.1) to examine the data.

The DEA analysis was conducted in a Polish specialist hospital. The hospital under consideration provides diagnostics, therapy, care, specialist advice, education prevention and health promotion. The unit of analysis was the hospital ward (DMU). Inputs and outputs data was collected from the hospital database and concerns 19 578 patients admitted to 14 departments between January and June 2017. DEA analysis has been performed on DMUs which produce only inpatient care in order to control their potential heterogeneity. The literature (Ancarani et. al., 2009) considers that the main source of heterogeneity among the DMUs is the one between units producing inpatient care versus those producing outpatient care.

Hospitals treat a variety of patients using several different inputs. Inputs and outputs for the DEA analysis were derived based on previous healthcare studies (Kirigia, 2002). Most often, operating costs, the number of hospital beds and Full Time Equivalent (FTE), the number of personnel, total assets (assets), complexity of services measured by the number of clinical services offered, number of doctors and the number of beds are used as inputs. Whereas outputs include: the number of days of hospitalization, the number of surgical procedures, weighted admissions, number of surgical interventions. The input measures used in other studies regarding hospital wards were: doctors' and nurses' gross wages, total personnel costs and materials and energy consumption, whereas the output measures were: the number of in-patients and outpatients, bed productivity, and average turnover interval, number of bed-days, DRG points and income from medical activity (Al-Shayea, 2011; Grzesiak and Wyrońska, 2014).

Finally, four input measures and two output measures were selected to measure the efficiency for each department. In this paper, medical wages (1), drugs (2) diagnosis tests (3) and the numbers of departments' beds are used as inputs. They are presented in table 1. The first three inputs were measured by costs. Costs in PLN were converted to Euros on the basis of average exchange rate of Polish National Bank (NBP) from 07.05.2018 (1€ = 4,2513).

The largest department, in terms of beds, is Gynecology-Obstetrics and Oncological Gynecology Department. In relation to of medical wages the most expensive is the Cardiac Surgery Department (1383,96€) and Anesthesiology and Intensive Care Department (1464,29€). The last one is also the most expensive in terms of drug costs (2494,34 €).

Table 1 Descriptive Statistics for Data Envelopment Efficiency Model Variables Inputs

Department of	Medical wages costs(€)	Drug costs (€)	Diagnosis tests costs (€)	Number of beds
	Mean (SD)			n
Rehabilitation	273,70 (138,33)	48,48 (76,24)	5,75 (18,63)	5
Transplantology and General Surgery	158,53 (328,41)	185,10 (629,23)	97,88 (142,14)	20
Anesthesiology and Intensive Care	1464,29 (1428,63)	2494,34 (4447,5)	227,26 (274,89)	15
Cardiac Surgery	1383,96 (1206,08)	637,91 (1397,4)	54,17 (60,91)	20
Endocrinology, Diabetology and Internal Diseases	75,13 (70,10)	132,29 (712,44)	36,84 (55,20)	18
Traumatic, Orthopedic Surgery and Spine Surgery	84,01 (65,71)	50,39 (98,66)	32,67 (60,73)	35
Neurosurgery	86,30 (83,41)	127,78 (309,87)	70,79 (150,62)	30
Gastroenterology	150,97 (166,61)	80,86 (239,85)	83,72 (89,70)	16
Neurology	124,07 (102,19)	141,56 (577,43)	98,92 (181,62)	24
Vascular Surgery	107,76 (140,81)	123,03 (315,38)	175,67 (257,34)	20
Ophthalmological	42,70 (41,31)	43,93 (84,76)	2,75 (16,56)	18
Hematology	153,60 (365,29)	563,38 (1015,5)	60,15 (212,40)	14
Cardiology	62,66 (96,60)	61,55 (214,69)	16,91 (39,64)	45
Gynecology-Obstetrics and Oncological Gynecology	70,25 (117,45)	81,98 (434,63)	12,98 (53,89)	76

Source: own elaboration

There is no consensus regarding the measurement of hospital outputs. Generally, the chosen output vector depends on available data and problem to be analyzed (Magnussen, 1996). In this paper we used as outputs number of bed days (1) and number of inpatients (2) that are presented in table 2.

Table 2 Descriptive Statistics for Data Envelopment Efficiency Model Variables Outputs

Department	Bed days Mean (SD)	Patients (n)
Rehabilitation	28,58 (11,66)	98
Transplantology and General Surgery	4,98 (5,00)	415
Anesthesiology and Intensive Care	12,04 (11,17)	458
Cardiac Surgery	9,32 (7,04)	472
Endocrinology, Diabetology and Internal Diseases	4,33 (3,14)	892
Traumatic, Orthopedic Surgery and Spine Surgery	4,16 (2,91)	934
Neurosurgery	5,05 (4,48)	1120
Gastroenterology	3,82 (4,29)	1122
Neurology	6,69 (5,11)	1412
Vascular Surgery	5,88 (7,54)	1528
Ophthalmological	2,41 (1,95)	1582
Hematology	3,19 (4,23)	1608
Cardiology	4,16 (3,38)	3094
Gynecology-Obstetrics and Oncological Gynecology	6,75 (5,22)	4843

Source: authors' own elaboration

The biggest clinical department in terms of number of patients is the Department of Gynecology-Obstetrics and Oncological Gynecology, accounting for almost 25% of all admitted patients to the hospital. The longest hospitalization took place at the

Rehabilitation Department (28,58 days) and at Anesthesiology and Intensive Care Department (12,04 days). On average, the shortest stay in hospital was in case of patients admitted to Ophthalmological Department (2,41 days).

3 Results and Discussion

The efficiency measures are summarized in table 3. It is important to note that efficiency scores range from 0 (totally inefficient) to 1 (100% efficient). Based on the paper's results out of the 14 departments included in the analysis, only 5 clinical departments (35,71%) run efficiently, while the remaining 9 (64,29%) were inefficient. Previous studies reported from 41,66 to 48,88% hospital departments run 100% efficient. For example Al-Shayea (2011) reported 4 out of 9 departments (44,44%) perceived as 100% efficient. In turn Hofmarcher et. al, (2002) reported that 20 of 48 operative departments and 22 of 45 non-operative departments had an efficiency level of 100%. We presume that these differences are related to the inputs and outputs used in DEA analysis, what is also confirmed in Magnussen and Nyland (2008) findings. Our study shows that the efficient departments with the highest score were the Departments of Hematology, Gynecology, Vascular Surgery, Rehabilitation and Ophthalmology. Among the efficient departments, 3 (60%) provide surgical procedures, which is similar to Al-Shayea (2011) findings which revealed that half of the 100% efficient departments were surgical (Obstetrics and Gynecology Department and Orthopedic Department). Among the inefficient departments, 1 department (11%) had an efficiency score between 91-99%, 6 (66%) between 70-90%, and 2 (22%) a score below 50%. The least efficient was the Department of Transplantology and General Surgery (38,10% E). Al-Shayea (2011) reported 66,66% of hospital departments with efficiency score below 50%. The reason for such a low efficiency in the departments of the last group (with their efficiencies values maintained below 50%) is the highest levels for input expenditures relative to their outputs. Therefore, in order to increase their efficiencies, the input expenditures for those departments must be decreased through cost control policy. The efficient wards on average admit more patients per year than inefficient wards. The exception is the rehabilitation department, which admits the least number of patients, but on the other hand it features the highest number of bed-days. The frequent explanation is that large amounts of fixed capital in efficient departments allows for the spreading of fixed cost across a greater volume of output. Increasing of efficiency in other wards is possible e.g. by better utilization of existing equipment, eliminating duplications of services and/or equipment, the sharing of overhead costs such as laboratory and diagnostic facilities.

Table 3 Efficiency Measures in Terms of Type of Department

Department	Efficiency (E)	Surgical/n onsurgical	Ranking
Rehabilitation	1,000	NS	1
Transplantology and General Surgery	0,381	S	10
Anesthesiology and Intensive Care	0,714	NS	8
Cardiac Surgery	0,467	S	9
Endocrinology, Diabetology and Internal Diseases	0,745	NS	6
Traumatic, Orthopedic Surgery and Spine Surgery	0,878	S	4
Neurosurgery	0,706	S	7
Gastroenterology	0,865	NS	5
Neurology	0,897	S	3
Vascular Surgery	1,000	S	1
Ophthalmological	1,000	S	1
Hematology	1,000	NS	1
Cardiology	0,924	NS	2
Gynecology-Obstetrics and Oncological Gynecology	1,000	S	1

Source: own elaboration

The DEA approach has demonstrated that 64,29% of clinical departments run inefficiently, and they thus need to either reduce their inputs or increase their outputs in order to be rendered efficient. While the clinical departments' managers/doctors may have limited impact on outputs, they can seek to affect inputs. Due to the nature of

health case involving a better control of inputs than outputs, the DEA input oriented model is used to identify potential improvements applicable in the inefficient departments in order to become 100% efficient. Total inputs reduction needed to make inefficient clinical departments efficient are presented in table 4.

Table 4 Total Input Reduction to Make Inefficient Clinical Departments Efficient

Department of	Medical wages costs (€)		Drug costs (€)		Diagnosis tests costs (€)	
	Original value	Predicted value	Original value	Predicted value	Original value	Predicted value
Rehabilitation	26822,45	26822,45	4750,90	4750,90	563,42	563,42
Transplantology General Surgery	65790,86	25072,76	76816,21	28384,74	40620,83	3872,42
Anesthesiology and Intensive Care	670645,30	70002,60	1142406,00	47070,34	104084,80	59314,15
Cardiac Surgery	653228,00	61111,61	301095,20	101370,70	25567,54	11946,31
Endocrinology, and Internal Diseases	67018,15	49913,74	118006,60	55515,91	32864,93	6846,83
Traumatic, Orthopedic Surgery	78464,29	54344,27	47064,70	41313,29	30510,37	2760,58
Neurosurgery	96654,09	68239,64	143119,80	77396,63	79288,69	10663,74
Gastroenterology	169386,30	71471,97	90726,20	78518,88	93933,37	57616,13
Neurology	175193,60	139030,50	199891,20	179368,00	139671,70	125331,60
Vascular Surgery	164657,50	164657,50	187986,40	187986,40	268430,50	268430,50
Ophthalmological	67553,54	67553,54	69493,22	69493,22	4358,43	4358,43
Hematology	246982,80	246982,80	905910,50	905910,50	96726,47	96726,47
Cardiology	193870,40	171897,10	190433,70	176030,20	52337,05	19389,24
Gynecology- Obstetrics	340242,90	340242,90	397060,30	397060,30	62878,10	62878,10

Source: own elaboration

In this table, the predicted value of an input variable represents the amount to which a given DMU can decrease its consumption of that specific variable. It is noticed that the Departments of: Transplantology and General Surgery; Anesthesiology and Intensive Care; Cardiac Surgery; Endocrinology; Traumatic, Orthopedic Surgery, in addition to departments in Neurosurgery; Gastroenterology; Neurology and Cardiology have to decrease all their input expenses by specific amounts in order to reach the targeted level shown in order to be efficient. If inefficient wards can reduce their inputs to the corresponding predicted target value, then, they would become efficient. In general, nine departments need to reduce their wage costs, drug costs and diagnosis tests costs in order to become efficient. The savings that can be achieved are considerable and in many cases exceed 90%. In the case of Cardiac Surgery Department medical wages should be lower by 91%, which would allow for savings in the amount of 592 thousand Euros. The largest suggested savings for drug costs relate to the Anesthesiology and Intensive Care Department (96%), and for diagnosis tests costs for Traumatic, Orthopedic Surgery and Spine Surgery Department (91%).

4 Conclusions

Clinical departments beside administrative and technical support and ancillary services are core units of a hospital (Magnussen, Nyland, 2008). Because hospital departments are the largest component of the hospital, to a large degree, efficiency of the clinical departments determines the hospital efficiency. The DEA analysis provides information about the surface where inputs are wasted and not utilized in production of hospital services.

With this information, managers will be able to make informed choices in relation to an increased efficiency path. Since hospital managers generally have more control over their inputs, they may devote more attention to the examination of total inefficiencies generated by excessive input usage. However, examinations of output inefficiencies can also provide strategic direction for the hospital by indicating where to increase its efficiency. The DEA is more informative than the other efficiency measurement methods

and can be successfully implemented in situations in which multiple inputs are used for producing multiple outputs. Hospital managers can use DEA results as inputs in decision-making processes involving resource planning, allocation, and utilization. By analyzing output inefficiencies and excess inputs, managers can attempt to make hospital and health systems rational and efficient.

The DEA not only allows for the identification of areas of improvement, but also indicates the realisation of the development. It also addresses questions regarding the strengths and weaknesses of the units and their optimal size. Systematic evaluation of units in the health care sector can bring considerable benefits to hospitals. The analysis and the results derived enhance the understanding of the effectiveness of various departments in comparison with other units. The results also indicate achievable results, scale of possible savings and factors that have the greatest impact on the units' efficiency.

References

- Al-Shayea, A. M. (2011). Measuring hospital's units efficiency: A data envelopment analysis approach. *International Journal of Engineering & Technology*, vol. 11(6), pp. 7-19.
- Ancarani, A., Di Mauro, C., Giammanco, M. D. (2009). The impact of managerial and organizational aspects on hospital wards' efficiency: Evidence from a case study. *European Journal of Operational Research*, vol. 194(1), pp. 280-293.
- Cook, W. D., Tone, K., Zhu, J. (2014). Data envelopment analysis: Prior to choosing a model. *Omega*, vol. 44, pp. 1-4.
- Charnes, A., Cooper, W. W., Rhodes, E. (1979). Measuring the efficiency of decision-making units. *European journal of operational research*, vol. 3(4), pp.339.
- Chilingerian, J. and D. Sherman (1990). Managing physician efficiency and effectiveness in providing hospital services. *Health Services Management Research*, vol. 3, pp. 3-15.
- Grzesiak, S., Wyrozębska, A. (2014). Wykorzystanie metody DEA (analiza obwiedni danych) do oceny efektywności technicznej oddziałów szpitalnych. *Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania*, vol. 36.
- Hofmarcher, M. M., Paterson, I., Riedel, M. (2002). Measuring hospital efficiency in Austria—a DEA approach. *Health Care Management Science*, vol. 5(1), pp. 7-14.
- Magnussen, J., Nyland, K. (2008). Measuring efficiency in clinical departments. *Health policy*, vol. 87(1), pp. 1-7.
- Kirigia, J. M., Emrouznejad, A., Sambo, L. G. (2002). Measurement of technical efficiency of public hospitals in Kenya: using data envelopment analysis. *Journal of medical systems*, vol. 26(1), pp. 39-45.
- Ludwig, M. (2008). *Efficiency of Dutch hospitals*. Maastricht: Maastricht University. Doctoral dissertation.
- Magnussen, J. (1996). Efficiency measurement and the operationalization of hospital production. *Health services research*, vol. 31(1), p. 21.
- Magnussen, J., Nyland, K. (2008). Measuring efficiency in clinical departments. *Health policy*, vol. 87(1), pp. 1-7.
- Nakagawa, Y., Yoshihara, H., Nakagawa, Y. (2011). New indicators based on personnel cost for management efficiency in a hospital. *Journal of medical systems*, vol. 35(4), pp. 625-637.
- Nyhan, R., Cruise, P. (2000). Comparative performance assessment in managed care: DEA for health care managers. *Managed Care Quarterly*, vol. 8(1), pp. 18-27.
- Palmer, S., Torgerson, D. J. (1999). Economics notes: Definitions of efficiency. *BMJ: British Medical Journal*, vol. 318(7191), p. 1136.

Steinman, L., Zweifel, P., (2003). On the inefficiency of Swiss hospitals. *Applied Economics* vol. 35, pp. 361–370.

Suchecka, J. (2011). *Finansowanie ochrony zdrowia. Wybrane zagadnienia*, Warszawa: Wolters Kluwer Polska.

Varabyova, Y., Schreyögg, J. (2013). International comparisons of the technical efficiency of the hospital sector: panel data analysis of OECD countries using parametric and non-parametric approaches. *Health Policy*, vol. 112(1), pp. 70-79.

Vincova, K. (2005). Using DEA model to measure efficiency. In: *Analysis of aspect of competitiveness and readiness of selected Slovak Companies for EU membership*. Kosice.

The Impact of Educational Expenditures and Higher Education Attainment on Employment in V4 Countries

Darya Dancaková

Technical University of Kosice
Faculty of Economics, Department of Banking and Investment
Němcovej 32, 04001 Košice, Slovak Republic
E-mail: darya.dancakova@tuke.sk

Abstract: *This paper provides an empirical analysis of the relationship between government expenditures on education and employment rates within V4 countries by comparison with European top performer: Germany. It is generally known that education is nowadays the most important weapon of nations, recognized as the key driver of productivity and economic growth in the knowledge-based economies. A framework for developing and well-skilled/educated workforce can be achieved through the motivation in the public sector to create, share and transmit knowledge. We start with the assumption that the higher level of education of the working age population may cause an employment growth and thus can have a significant impact on economic growth overall, since the sustainable development of economy and society is closely related to education. The goal of this study is to point out the relationship between government expenditures on education and employment growth with aim to estimate whether government spending on education and the higher level of educational attainment have a significant impact employment rates in selected countries.*

Keywords: *employment rate, education level, education, government expenditures on education*

JEL codes: *I22, I23, J21, J24, H52*

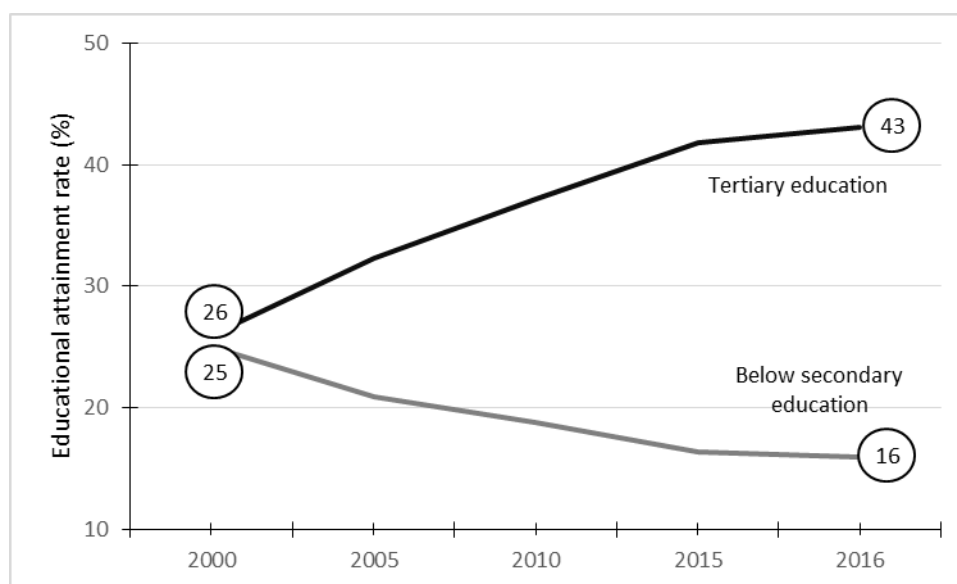
1 Introduction

In contemporary society the meaning of education has changed dramatically. Now we are witnessing the growing demand for intellectual activities related to knowledge production in all spheres of social and economic life. The question of relationship between education and employment has been a subject of discussions for a long time. The essential link between education and economic development of the country has been revealed already during the industrial age by such economists like W. Petty, A. Smith, or J.S. Mill (Youngson, 1959). From an economic perspective, education can be viewed as an investment in knowledge and skills of population. Speaking about investing in education, it is necessary to mention Schulz (1960), who proposed to treat education as an investment in individual that becomes an integral part of a person receiving it, and therefore its consequences shall be handled as a form of capital referring to the human capital. The human capital theory was popularized by Becker (1992) and it became one of the most important theories of modern economics. It puts emphasis on education of individuals, since the well-skilled labour promotes economic growth, individual wellbeing and poverty reduction. Vawda (2003) suggested that investing in people in form of government spending is critical for economic and social development of the country, since it may help to achieve greater equity and efficiency in education among young people. According to the Dissou, et al. (2016), expenditures on education, schooling and training will raise labour productivity, earnings, improve general welfare and foster economic growth. Never-ending learning equips people with new skills, enabling them to express themselves and critically evaluate the world around. Some researchers have also demonstrated that higher education makes employees more productive for carrying out their work (Ng & Feldman, 2009; Kotur & Anbazhagan, 2014). Moreover, the schooling promotes individuals to think creative and makes them able to come up with new ideas and to think out of the box. Additionally, better educated people can benefit from a higher income from their work and they are less at risk of unemployment. This fact has been pointed out by Mincer (1991), as he stressed that better educated workers can enjoy several advantages over less

educated people in the labour market: higher wages, greater upward mobility in income and career opportunities, and, finally, greater employment stability. Among other things, Hanushek (2009) asserted that education is an essential element in a global economic competition and investments in human capital will directly affect the improvements in productivity and national income, because national income rises directly with earnings from workers with more qualification and better skills. Promoting and supporting education should be, therefore, one of the top priority areas of government's development policy around the world. Relationship between higher level of education and employment has been demonstrated by Berger & Parkin (2009), as they found out that graduates with post-secondary and higher education are more likely to be employed in comparison to those who did not continue their studies after attaining a high school.

The recent study "Education at a glance" prepared by OECD (2017), has shown an upward trend towards a higher education in OECD and partner countries. The Figure 1 demonstrates the educational attainment rates (%) among 25-34-year-olds across OECD countries.

Figure 1 Educational Attainment Rate Among Young Adults in OECD



Source: Own elaboration from „Education at a glance 2017“, OECD

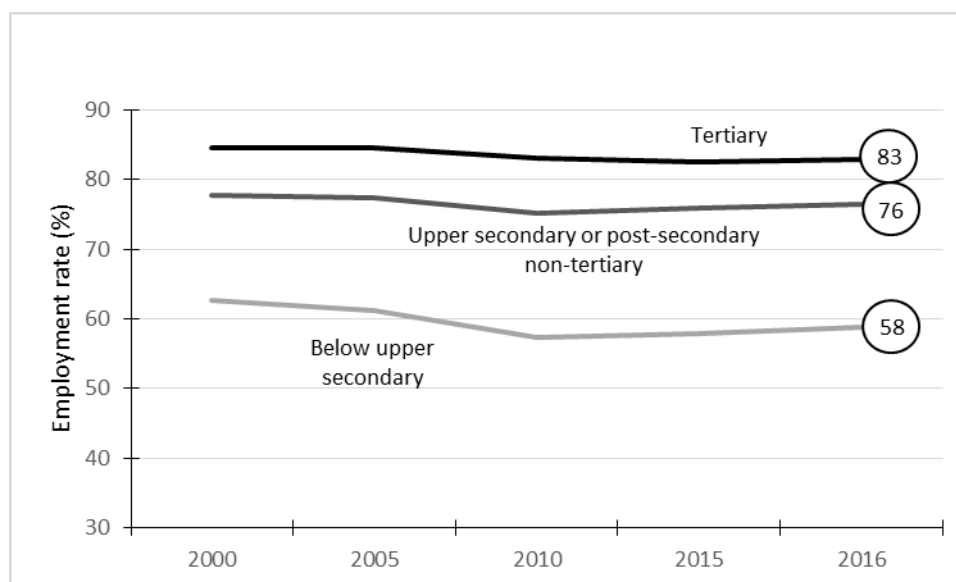
Since 2000, the labour force has become more educated across OECD and partner countries. The share of young people and adults with only one level of education, below secondary education, has tended to decrease over the monitored period and reached only 16 % in 2016 on average across OECD countries. By contrast, we are witnessing the steady growth trend in demand for higher education. The share of young adults with tertiary education has increased over the period, from 26% in 2000 to the new high of 43 % in 2016.

The educational situation in V4 countries has been following the similar trend. The proportion of young adults with tertiary education increased from 11% to 33% in Czech Republic. At the same time, the number of young people with below secondary education hasn't changed dramatically over the mentioned period, from 8% in 2002 to 7% in 2016. Educational patterns in Slovak Republic followed the same trend as observed in Czech Republic. The change in educational attainment rates was slightly bigger in Hungary than in Czech Republic and Slovakia. The share of higher educated young adults has increased rapidly, from 15% in 2000 to 30% in 2016. This trend was followed by a declining number of young population with educational level below secondary education, from of 19 % to 15%. The pattern of Hungarian educational attainment rates can be compared to the pattern in Germany, where the number of less educated people has fallen from 15% to 13%, and the proportion of those with higher education have risen from 22% to 31% over

the whole period. The most striking change in higher education attainment rates among 25-34-year olds was observed in Poland, where numbers have significantly increased since 2000-16, from 14% to 43% and have reached an OECD's average. The share of young adults with lower education has also decreased dramatically, from 11% to 6%.

Educational attainment is often used as a measure of the skills and knowledge available at the job market. It provides an initial information of employee's potential capabilities, which a prospective employer will use to decide whether or not the new employee will be hired. The fact that the level of education has a significant impact on the employment rates has been statistically demonstrated by OECD in Figure 2.

Figure 2 Employment Rate by Educational Attainment in OECD



Source: Own elaboration from „Education at a glance 2017“, OECD

On average across OECD countries, employment rates for people with tertiary education tend to be higher than for those with lower than secondary education. The latest research has shown that 83% of the population among 25-34-year-olds with tertiary education is employed. The OECD average falls to 76 % for young adults with upper secondary or post-secondary non-tertiary education and to 58% for those without upper secondary education. This implies that individuals with tertiary education have greater chances to be employed in comparison with those who haven't attained a tertiary education. In the current context the economies and labour markets are highly dependent on sufficient supply of well-educated workforce. In Germany, on average employment rates are more than 30 percentage points higher for those with tertiary education than for those who have not completed an upper secondary education. In Czech Republic on average 46 % among 25-34-year-olds with educational level below upper secondary is employed, those who have completed secondary education and those with tertiary have almost the same chance to be employed with employment rate on average of 78%. The employment rates by education level have followed the similar pattern in Germany, Hungary, Poland and Slovakia. The share of young adults with upper secondary and post-secondary non-tertiary education who are employed is on average 75% in selected countries. The proportion of those with tertiary education is on average about 84 %. Graduates with education level below upper secondary have greater opportunities in the labour market in Germany, with average rate of 56%. By contrast, the lowest employment rate of less educated people was observed in Slovakia, on average about 36%. Employment rates development across V4 and Germany confirms the trend that higher education leads to higher employability among 25-34-year olds.

Gylfason (2001) insisted that faster economic development requires better education of population, and consequently it should be accompanied with higher spending on schooling

and training. At the same time, government spending on education and direct job creation could be viewed as a potential engine for generating employment and thus reducing poverty and inequity, as argued by Abdulah, Harun & Jali (2017). Likewise, Pirim, Ownings & Kaplan (2017) examined the impact of educational expenditures on unemployment rates and public health, and concluded that investment in human capital has positive economic outcomes, since the higher spending on individual s education has been associated with decrease in unemployment rates, and hence increase in employment rates.

2 Methodology and Data

The methodology of this study is mostly based on the model proposed by Grimaccia and Lima (2013). Authors confirmed a hypothesis of the positive impact of government educational expenditures on employment growth. To test their assumption, they have designed a model, as shown below:

$$EMPL = f(GDP, EDU, UNIV), \text{ where} \quad (1)$$

EMPL is employment rate of working age population (%); EDU is GDP per capita; EDU is government expenditure on education (primary, secondary, tertiary total % of GDP); and INIV is a share of working age population with tertiary education (%).

The model used in this study was based on the model proposed by Grimaccia and Lima (2013), with adding an addition variable to the model: government expenditure on direct job creation. To estimate the effect of selected variables on the employment rate in countries of Visegrad Group and Germany, the ordinary least squares (OLS) method on the panel data in Gretl was used. The annual data was obtained from the OECD database for the period of 2000 to 2014. The base model was specified in the following functional form:

$$EMP = \alpha + \beta_1 GDP_{it} + \beta_2 GEXPEDU_{it} + \beta_3 TEA_{it} + \beta_4 GEXPJOB_{it} + \varepsilon_i, \quad (2)$$

where EMP is for dependent variable: employment rate of working age population (%); GDP_{it} is independent variable for GDP growth (%); $GEXPEDU_{it}$ is independent variable for government expenditure on education (primary, secondary, tertiary, total, % of GDP); TEA_{it} is independent variable for a share of working age population between 25-64-year-olds with tertiary education (%); $GEXPJOB_{it}$ is independent variable for government expenditure on direct job creation (% of GDP).

3 Results and Discussion

The main goal of this study was to test the hypothesis of the positive impact of the government educational expenditures on employment rates in selected countries. The second aim was to estimate an impact of tertiary education attainment and government expenditures on education and direct job creation on employment rate. Therefore, the multivariate ordinary least squares regression model including all selected explanatory variables have been built. The growth of GDP was selected as a control variable in the model. However, not all explanatory variables appeared to be significantly related to the employment rate. Hence, the insignificant variables with p-value > 0,05 have been removed from the base model. Table 1 shows the empirical results of the final model:

Table 1 The Final Model of Pooled OLS V4 Countries

Variable	Coefficients	p-value
Constant	79,0949	2,10e ⁻³¹ ***
GEXPEDU	-5,36007	6,16e ⁻¹⁰ ***
TEA	0,274341	0,0112 **

Note: ***, **, * denote significance levels on 1%, 5% and 10% respectively. R-Squared is 0,499551. According to White's test, there is a heteroscedasticity presented in the model, LM = 17,3087. Residuals are not distributed normally, Chi-square=7,3732.

Source: own elaboration

Based on the OLS analysis, the total government expenditure on education and the share of population with tertiary education would appear to be significantly related to the employment rate in V4 countries. However, each unit increase in government expenditure on education is being associated with a decrease of 5,36007 units in employment rates. Consequently, the hypothesis of the positive impact of government educational expenditures on employment rates should be rejected. On the other hand, the tertiary education attainment of working age population positively affects the employment rates in V4 countries with each unit increase in tertiary education attainment being associated with 0,274341 units increase in employment rates.

According to the F-statistic of overall significance, the final model showed in the Table 1 is statistical significant, with p-value = $3,82e^{-9}$ and R-Squared value of 0,499551, which indicates that the model explains approximately 50% percent of the variation in the dependent variable - employment rate. To determine whether the residuals follow a normal distribution, the p-value of a normality test was compared to the significance level of 0,05. The p-value = 0,025057 is less than the significance level, so the decision is to reject the null hypothesis (H_0 : error is normally distributed) and conclude that residuals do not follow a normal distribution. The heteroskedasticity test showed the presence of heteroskedasticity with p-value=0,00395002, so the null hypothesis (H_0 : heteroskedasticity not present) is to be rejected. The diagnostic test of cross-sectional dependence showed that the data is cross-sectional independent, with p-value=0,4503 the null hypothesis (H_0 : no cross-sectional dependence) is not rejected.

Since not all assumptions of ordinary least squares approach have been fulfilled, to fix the problem with heteroskedasticity and non-normality of residuals, the logarithmic transformation of the model was made. Table 2 shows the empirical results of the final model:

Table 2 The Final OLS Model with Logarithmic Transformation V4 Countries

Variable	Coefficients	p-value
Constant	4,46572	$2,15e^{-46}$ ***
lnGEXPEDU	-0,413114	$3,61e^{-10}$ ***
lnTEA	0,0848173	0,00055 ***

Note: ***, **, * denote significance levels on 1%, 5% and 10% respectively. R-Squared is 0,508736. According to White's test, there is a heteroscedasticity presented in the model, LM = 15,4833. Residuals are not distributed normally, Chi-square=7,68753.

Source: own elaboration

The data, shown in the Table 2, have been transformed using the logarithm function. As in the previous model, the total government expenditure on education and the share of population with tertiary education would appear to be significantly related to the employment rate in V4 countries. And again, the same counts: the hypothesis of the positive impact of government educational expenditures on employment rates is rejected, since each unit increase in government expenditure on education is being associated with a smaller decrease of 0,413114 units in employment rates. The positive effect of tertiary education on employment rates is being accompanied by 0,0848173 unit increase in employment rates with each unit increase in tertiary education attainment of working age population.

This model is statistical significant with p-value of overall significance = $2,27e^{-9}$ and it explains approximately 50% of the variation in the employment rates with R-Squared = 0,508736. The data are cross-sectional independent with p-value of the cross-sectional dependence test = 0,751942. However, the logarithmic transformation did not fix the issue of heteroskedasticity presence (p-value=0,0084851) as well as non-normality of residuals (p-value=0,0214128). To fix the problem with heteroskedasticity and non-normality was decided to use weighted least squares method (WLS), which yields greater efficiency than OLS. To identify what explanatory variable causes heteroskedasticity, the dispersion analysis was made. The variable tertiary education attainment has the highest dispersion

among other variables, so it has been chosen as a weight in WLS model. The results of the WLS analysis are shown in the Table 3:

Table 3 The Final WLS Model V4 Countries

Variable	Coefficients	p-value
Constant	78,8942	1,18e ⁻³⁰ ***
GEXPEDU	-5,31577	1,28e ⁻⁹ ***
TEA	0,274287	0,0083 ***

Note: ***, **, * denote significance levels on 1%, 5% and 10% respectively. R-Squared is 0,488343. There is no heteroskedasticity presented. Residuals are not distributed normally, Chi-square=7,53149.

Source: own elaboration

Results from the WLS analysis are very similar to the previous two approaches. The significant negative impact on employment rates across V4 countries has government expenditure on education with β coefficient = -5,31577, which means decrease in employment rates associated with each unit increase in government expenditure on education. Contrariwise, employment rates will increase by 0,274287 units, if tertiary education attainment among working age population increases by one unit.

The WLS approach removed heteroskedasticity from the model. According to the F-statistic of overall significance, the WLS model is significant with p-value of 7,10e⁻⁹ and it explains approximately 48,8% of the variation in the employment rates with R-Squared = 0,488343. There is no collinearity between explanatory variables presented. However, the residuals are not normally distributed at significance level = 0,05 with p-value = 0,0231504.

The same methodology was applied to estimate the unknown parameters in a linear regression model of employment rate in Germany. The results of logarithmic OLS model, which fixed the issue with heteroskedasticity, are shown in the Table 4:

Table 4 The Final Logarithmic OLS Model Germany

Variable	Coefficients	p-value
Constant	3,87392	1,83e ⁻¹⁶ ***
lnGEXPJOB	-0,0433545	0,0008 ***
lnGDP	0,00606478	0,5278

Note: ***, **, * denote significance levels on 1%, 5% and 10% respectively. R-Squared is 0,733965. According to Breusch Pagan's test, there is no heteroscedasticity presented in the model, LM = 4,62606. Residuals are distributed normally, Chi-square=1,35977.

Source: own elaboration

After removing all insignificant explanatory variables, the only variable that appeared to be significant was government expenditures on direct job creation. One would expect that the expenditure on job creation would have a positive impact on the employment rate, but in fact the reverse is true. Each unit increase in government expenditure on direct job creation is being associated with 0,0433545 decreases in employment rate. For comparison only: this variable did not appear to be significant in V4 countries and vice versa the significant variables in V4 models did not appear to be significant in model for Germany.

According to the F-statistic, the model is significant as a whole, with p-value=0,002584 and it can explain approximately 73% of the variation in the employment rate. Diagnostic tests showed that residuals are following the normal distribution (p-value = 0,506676); there is no heteroskedasticity presented in the model (p-value = 0,0989611).

Based on the results from the OLS model in Germany, it is not possible to confirm the hypothesis that the model proposed by Grimaccia and Lima (2013) is suitable for explaining the relationship between government educational expenditures and employment rates, as well as to identify the impact of other variables (tertiary education attainment, government expenditure on direct job creation) on the employment rates in selected countries.

4 Conclusions

The main objective of this study was to identify the relationship between government expenditures on education and employment rates within V4 countries and European top performer Germany. The study was based on the model of the employment rate proposed by Grimaccia and Lima (2013). Based on the results of this study, the hypothesis of the positive impact of government educational expenditures on employment rates has been rejected. The effect of government educational expenditures has proved to be negative for employment rates in V4 countries, and even its impact has not been proven in Germany. This fact may be caused by several aspects: the model thus defined is not specified correctly, this means that such combination of selected variables does not make sense from the statistical point of view, or there is no direct relationship between the government expenditures on education and employment rates. Therefore, it seems to be inappropriate to presume that employment rate can be directly affected by the expenditures on education. Moreover, this model did not appear to be well suited for determining the relationship as mentioned above, for several reasons: there was a huge problem with heteroskedasticity and non-normality in the residuals at significance level of 0,05, what means that the amount of error in the model is not consistent across the full range of the observed data. Consequently, the amount of predictive ability in explanatory variables is not the same across the full range of the dependent variable. Thus, the model does not fully explain the behavior of the system as a whole.

Acknowledgments

This research was supported by VEGA project No. 1/0311/17 on Measuring and Reporting Intangible Assets

References

- Abdullah, M. B., Harun, M., Jali, M. R. M. (2017). Employment Generated by Government Spending on Education. *International Journal of Academic Research in Business and Social Sciences*, vol. 7(2), pp. 738-742.
- Becker, G. S. (1992). Human capital and the economy. In: *Proceedings of the American Philosophical Society*. United States: American Philosophical Society, vol. 136(1), pp. 85-92.
- Berger, J., Parkin, A. (2009). The value of a degree: Education, employment and earnings in Canada. *Women*, vol. 2(1.8), pp. 1-9.
- Dissou, Y., Didic, S., Yakautsava, T. (2016). Government spending on education, human capital accumulation, and growth. *Economic Modelling*, vol. 58, pp. 9-21.
- Grimaccia, L., Lima, R. (2013, September). Public expenditure on education, education attainment and employment: a comparison among European countries. In: *XXVIII Conference of the Italian Association of Labour Economists (AIEL) Rome*.
- Gylfason, T. (2001). Natural resources, education, and economic development. *European economic review*, vol. 45(4-6), pp. 847-859.
- Kotur, B. R., Anbazhagan, S. (2014). Education and work-experience-influence on the performance. *Journal of Business and Management*, vol. 16(5), pp. 104-110.
- Mincer, J. (1991). *Education and unemployment (No. w3838)*. Cambridge (USA): National bureau of economic research.
- Ng, T. W., Feldman, D. C. (2009). How broadly does education contribute to job performance?. *Personnel psychology*, vol. 62(1), pp. 89-134.
- OECD (2017). *Education at a Glance 2017: OECD Indicators*. Paris: OECD Publishing. DOI: <http://dx.doi.org/10.1787/eag-2017-en>.

- Pirim, Z., Owings, W. A., Kaplan, L. S. (2017). The Long-Term Impact of Educational and Health Spending on Unemployment Rates. *Journal of Economics and Financial Analysis*, vol. 1(2), pp. 49-69.
- Schultz, T. W. (1960). Capital formation by education. *Journal of political economy*, vol. 68(6), pp. 571-583.
- Vawda, A. Y. (2003). Who benefits from public education expenditures?. *Economic Affairs*, vol. 23(1), pp. 40-43.
- Youngson, A. J. (1959). *Possibilities of economic progress*. CUP Archive.

Sustainable Finance Instruments' Risk - Green Bond Market Analysis

Karolina Daszyńska-Żygadło¹, Jakub Marszałek², Krzysztof Piontek³

¹ Wrocław University of Economics
Faculty of Management, Computer Science and Finance, Institute of Financial Management
118/120 Komandorska Street, 53-345 Wrocław, Poland
E-mail: karolina.zygadlo@ue.wroc.pl

² University of Łódź
Faculty of Management, Department of Finance and Strategic Management
22/26 Matejki Street, 90-237 Łódź, Poland
E-mail: jmarszalek@uni.lodz.pl

³ Wrocław University of Economics
Faculty of Management, Computer Science and Finance, Institute of Financial Management
118/120 Komandorska Street, 53-345 Wrocław, Poland
E-mail: krzysztof.piontek@ue.wroc.pl

Abstract: Sustainable finance opportunities for retail investors such as green bonds are the example of instruments that are dedicated to transition of economy towards more sustainable model and are serving as a source of financing for large-scale investments. The paper aims at verification of volatility behaviour of green bond market and relationship of green bond market volatility and conventional bond market volatility. Our study sheds additional light to previous findings and extends the perspective, going beyond analysis of behaviour of S&P green bond index. Our study was conducted on a wider range of available green bond indices in order to draw more general conclusions. We studied daily rates of return in the period of 2014 – 2018 of the S&P Green Bond Index, Bloomberg Barclays MSCI Global Green Bond Index, ICE BofAM Green Bond Index, Solactive Green Bonds Index. Using multivariate GARCH framework we were able to verify and test volatility patterns and assess how the volatility of in the green bond market transmits to broader conventional bond market. Results of our study confirm that all green bond indices, experience large volatility clustering. We also found out that shocks in the overall conventional bond markets tend not to be echoed in the green bond market. Findings of this paper are significant from the perspective of providing informative insights for the investors risk and return characteristics. They also contribute to the development of sustainable finance and risk analysis of sustainable finance instruments.

Keywords: green bonds, eco-investments, global market, climate change, GARCH

JEL codes: F21, G15, O13, O16, Q50

1 Introduction

Transition of economy towards more sustainable model requires financing of large-scale investments mitigating climate change therefore there is a growing need for dedicated sustainable finance instruments. Those large-scale investment projects face difficulties in assessing their profitability in standard way, social and environmental impact is hard to assess in money terms. Although pro-ecological projects encounter growing interests from investors it is still small in scale and in reference to all financial instruments at capital markets. On the other hand, the growing sustainability awareness of societies creates pressure on participants of capital markets and increases interest in such investments.

The most significant instruments of sustainable finance – green bonds – meet the needs of modern world, its challenges and the expectations of investors. This is a specific type of bond whose proceeds are invested in an environmentally friendly goals with projects producing sustainable benefits. A “green” bond differentiates from a “traditional” bond by its label. That means the obligation to exclusively use funds raised from the issue to finance or refinance new or existing eligible green projects or business activities. Due to the fact that pro-ecological investments are burdened with significant financial risk related to the

uncertainty of expected results and encounter a barrier to obtaining capital, many green bonds are issued by public entities or international financial and development organizations. Offered instruments are most often issued in a secured or guaranteed form (Morel, 2012). Green bonds are perceived as most important financial instruments supporting sustainability transition. They are deliberately emphasized as financial instruments that should be promoted among retail investors. Especially in Europe, where the driving force is European Commission and different public institutions, such as EU High-Level Group on Sustainable Finance (HLEG 2018).

The specificity of the instruments themselves and the projects for which they are issued prompts research into the profile of investors acquiring green bonds. The purpose of this article is to verify volatility behaviour of green bond market and relationship of green bond market volatility and conventional bond market volatility. Results of this research are significant from the perspective of providing informative insights for the investors risk and return characteristics. They also contribute to the development of sustainable finance and risk analysis of sustainable finance instruments. We studied daily rates of return in the period of 2014 – 2018 of the S&P Green Bond Index, Bloomberg Barclays MSCI Global Green Bond Index, ICE BofAM Green Bond Index, Solactive Green Bonds Index. Using multivariate GARCH framework we were able to verify and test volatility patterns and assess how the volatility of in the green bond market transmits to broader conventional bond market. The paper is organized as follows. Section 2 provides analysis of characteristics of green bond market risk. Section 3 presents the data, methodology and research results, while section 4 provides discussion of results and concludes.

2 Green bond market risk aspects

Green bonds are a relatively recent innovation in the debt markets. Since their debut in 2007 through next 11 years over USD 348.9 billion were issued. Green bonds are expected to play an important role in responding to the existential threats and enormous costs posed by climate change and other sustainability challenges that have emerged in recent years. This financial instrument could be tied to mitigating the effects of climate change (e.g. climate bonds) or to a specific environmental issue or technology, such as wind and solar energy efficiency projects, energy retrofits and clean transportation (e.g. renewable energy bonds, energy efficiency bonds and green transportation bonds) (Green bonds: victory, 2013). However, the observations of the existing allocation of funds derived from the issue of green bonds might be surprising. The analysis of the structure of the issue's purpose indicates that pro-ecological nature of green bonds is quite controversial (Marszałek and Daszyńska-Żygadło 2016). Only two thirds of issuers declare an environmental goal, but it is not determined impact on environment the project has. The degree of generality of the ecological nature of the purpose of the green bond issue absolutely does not prejudge the lack of connection with environmental protection activity. However, there is an impression that many companies, especially corporations, use the status of green bonds to improve the attractiveness of the issue offer.

Green bonds do not differ from standard bonds, except for the fact that funds obtained by the issues are dedicated to certain green projects. Rate of return of this instrument is connected to the risk related to the uncertainty of the expected results. Risk reduction is guaranteed by a public or international organization. If the issuer is a non-public company, it is often guaranteed by a public entity. A common solution is the securitization involving the separation of selected assets to the Special Purpose Vehicle (SPV). It is also possible to award bonds with a climate certificate, which is usually equivalent to the instruments being covered by a guarantee of a public or international unit. The green bond risk may also be limited by the means of using a hybrid bond (Lee, Zhong, 2015). It involves financing a number of pro-ecological investments. Thanks to the diversification of the project portfolio, the overall risk is lower, and thus the bonds are more attractive to investors. Yet another solution is to use the revenue bond structure. An example of such an instrument is a carbon revenue bond (Tang et al., 2012). In addition, this investment may be supported by the legal protection of the state in the scope of exclusivity of benefits

or exemption from public levies. In the case of combining a diversified investment portfolio with the structure of the revenue bond, an attractive debt instrument for long-term financing is obtained (Mathews, Kidney, 2012).

Current research on the risk of green bonds indicates that green bonds would be less easy to sell in panic (Atkins, 2015). Investors are more likely to be long-term traders holding them to maturity (Schroders, 2015). However, there are mixed research results on how green bonds perform compared to the standard ones. Some economists argue that despite the lower liquidity in the green bond market yields and pricing of both types are the same (Petrova, 2016). Others show that green bonds deliver a lower yield (Schroders, 2015). A comparison of the basic characteristics of green and non-green corporate bonds with the same ratings indicates a minor difference between those two groups of securities (Kuna-Marszałek and Marszałek, 2017). Green bonds have slightly lower YTM value. In the context of growing green bond market, it can be explained that investors are willing to pay the price for being more socially responsible. A similar relationship can be observed in the case of the issuers. Green bonds have on average a higher coupon value as well. It is worth noting that the issuers additionally bear extra costs on labeling the bond "green". They also issue them for a shorter time, which allows for more flexible management of the investor's portfolio. Moreover, the research results show a positive relationship between corporate social responsibility and financial performance (in terms of return on assets, return on equity and non/net interest income) of financial institutions being intermediaries on green bond market (Wu and Shen, 2013). This may explain the acceptance of lower bond yields and higher financing costs. Green bonds attract investors with additional positive signaling effects (Tiselius and Kronqvist, 2015). Possible involvement of public institutions further reduces transaction costs.

The geography of the green bond market is expanding and diversifying. However, it is still concentrated to a limited number of geographies and sectors. The green bonds are still a niche product within the broader global debt-security market, and account for a small fraction of the overall bond market (European Commission, 2016). That is why the integrity of the green bonds market so far remains robust. Over the last years increasing numbers of specialized green bond funds as well as institutional investors which have intended to increase green bond holdings could be observed. This should result in a relatively lower volatility in the valuation of these instruments, as investors are aware of their purchase will not sell them as often as ordinary bond buyers. However, relatively little is known about the volatility of the valuation of green bonds in the context of changes in the broad bond market. Volatility analysis of S&P GB Index, GPB Index and U.S. AB Index in period 2010-2015 gives evidence for time-varying volatility spill-over between the green bond market and the conventional bond market (Pham, 2016). The green bond market's volatility is positively correlated with the conventional bond market. While one might find results of Pham (2016) inconclusive for various reasons, one being time period of analysis. Results may not be credible due to the fact that S&P Green Bond index was established in 2014, so the actual behaviour of the index is analysed only for one year. Another analysis of yearly volatility of Solactive Green Bond Index and MVIS EM Aggregate Bond Index shows that volatility of green bonds index grows stronger and faster than the aggregated bonds index (Daszyńska-Żygadło and Marszałek, 2018). However, this volatility achieves higher level than aggregated bonds index. It indicates that risk of investing in green bonds index is slightly higher than of the aggregated one. The analysis of the sensitivity of green bonds index for the changes of the broader conventional bonds index using estimated beta coefficients shows that along with the development of green bonds market the Solactive Green Bond Index reflects reactions on the changes on overall bonds market.

In the context of the above information, the problem of the risk of green bond estimation and analysis can be formulated. The specific purpose of the investment, often based on new, unproven technologies, will support the increase of risk. It may be additionally increased by the lack of legislative regulations concerning a given ecological activity. On the other hand, the involvement of a state or international institution, guarantees granted or public issuance will mitigate the risk. Investments implemented by green bonds are in fact socially important and cannot be subject to the same assessment as commercial

projects. This does not mean, however, that these investments should not be assessed or compared to commercial ventures but it is hard not to notice their uniqueness. This activity involves an emotional charge of the investor, as it concerns the future of humanity, is modern and innovative. Both investment funds and individual investors will take this into account when estimating the expected rate of return. It will also determine their market behaviour and stabilize volatility. However, the results of few studies in this area are not consistent. They point to greater and lesser risk of investing in green bonds compared to conventional bonds. Similar opposites are observed in the case of profitability of both groups of bonds. The research carried out in this article is to broaden the knowledge in that field and to contribute to finding behaviour patterns rates of returns and volatility in green bond market.

3 Data, methodology and research results

Our study is based on the framework to model the volatility of a financial asset based on the multivariate Generalized Autoregressive Conditional Heteroskedasticity (GARCH) framework, a family of statistical models originally proposed by Bollerslev (1986) and Engle (2002). That have been widely used in the literature studying the relationship between different financial time series' volatilities (Engle 2002; Glosten et al., 1993).

We use the sample composed of rates of returns of the following pairs of bond indices in order to investigate the patterns of green bond market in relation to overall conventional bond market:

- Bloomberg Barclays MSCI Global Green Bond Index Total Return Index Value Unhedged USD (GBGLTRUU) – Bloomberg Barclays US AGG TOTAL RETURN VALUE UNHEDGED USD
- ICE BofAM GREEN BOND INDEX (GREN) – Bloomberg Barclays US AGG TOTAL RETURN VALUE UNHEDGED USD
- S&P GREEN BOND INDEX TOTAL RETURN (SPUSGRN) – S&P AGGREGATE BOND INDEX TOTAL RETURN
- Solactive Green Bonds Index (SOLGREEN) – S&P AGGREGATE BOND INDEX TOTAL RETURN

Due to the fact that not every aggregated conventional bond index has a corresponding green bond index a selection of matching pairs was made based on the assumption of broad representation of bonds in a conventional bond index according to sector, issuer, class of risk and geography. This was the reason why, for example Solactive index was matched with S&P aggregate bond index.

We used daily logarithm returns for the periods matching official launch of green bond index with corresponding returns of aggregate bond index. A widely used technique to in the literature studying the volatility of financial time series is GARCH, which uses an autoregressive structure to model the conditional variance of a time series, thereby allowing volatility shocks to persist over time (Bauwens,et al., 2006; Teräsvirta; 2009)¹.

One feature of the multivariate GARCH model is that it allows time-varying conditional variances of asset returns' as well as covariances between the returns of different assets. This allows the analysis of the volatility structure of individual assets as well as the interaction between various assets. In this paper, the specification of this multivariate model consists of two components. First, returns are modeled using a vector autoregression framework. Then, a multivariate GARCH model is used to model the time-varying variances and covariances by analogy as in the study of Pahn (2006). In order to find a common pattern of behaviour same analysis was conducted on a wider sample of green bond indices, based on the list of The Green Bond Principles report (2017) we cover four out of six existing indices of that type, missing only the ChinaBond China Green Bond Index and ChinaBond China Green Bond Select Index that was launched in April 2016 and

¹ Due to limited required length of the paper equations were not included in the paper, but are available upon request from interested readers.

data is not available nor in Thomson Reuters Datastream neither in Bloomberg. Table 1 summarizes the descriptive statistics of the indices' returns.

Table 1 Descriptive Statistics of All Analyzed Indices

	Solactive green	S&P	MSCI green	Bloomberg Barclays aggreg	ICE BofAM green	S&P green
Mean	1.9844e-005	7.8521e-005	5.2415e-005	6.1037e-005	2.8270e-005	-7.2707e-007
Median	0.00013806	0.00015128	6.7405e-005	0.00016264	6.7442e-005	5.2781e-005
Minimum	-0.016462	-0.0086641	-0.016023	-0.0098160	-0.016620	-0.013850
Maximum	0.016675	0.0057227	0.016000	0.0059110	0.016466	0.014043
Std. Dev.	0.0036330	0.0017214	0.0036450	0.0019741	0.0037696	0.0032891
C.V.	183.07	21.923	69.541	32.342	133.34	4523.8
Skewness	-0.19146	-0.22316	-0.21083	-0.32579	-0.18948	-0.19201
Ex. kurtosis	1.7673	0.80985	1.3658	0.89008	1.5518	1.3786
5% Perc.	-0.0059690	-0.0027682	-0.005874	-0.0033046	-0.0063739	-0.005246
95% Perc.	0.0058089	0.0028734	0.0059301	0.0031373	0.0060113	0.0053230
IQ range	0.0041133	0.0021299	0.0043557	0.0024371	0.0041945	0.0038501

Source: own elaboration

Among the four green indices Bloomberg Barclays MSCI Global Green Bond Index has the highest average returns while the ICE BofAM Green Bond Index has the highest standard deviation.

In majority of our time series of indices returns the effect of autocorrelation wasn't found, but in order to verify given assumptions and findings of previous studies we conducted analysis according to indicated GARCH framework. First, returns were modelled using a vector autoregression framework. Then, a multivariate GARCH model was used to model the time-varying variances and covariances.

Table 2 Results of DCC Models Parameters Estimation

	Index	parameter	Index	parameter
w1		7,81E-08**		2,36E-08*
alpha1	Bloomberg	0,0155**		0,0166***
beta1	Barclays aggreg	0,9649***	S&P	0,9755***
w2		4,03E-07		6,59E-08
alpha2		0,0284*		0,0334**
beta2	MSCI green	0,9412***	Solactive green	0,9626***
corr		0,4643***		0,4037***
alpha		0,0991*		0,0773**
beta	pair	2,31E-06	pair	0,7825***
w1		9,17E-08*		4,47E-08*
alpha1	Bloomberg	0,018206***		0,018***
beta1	Barclays aggreg	0,959738***	S&P	0,9677***
w2		2,11E-07		1,83E-07**
alpha2		0,034484**		0,0283***
beta2	ICE BofAM green	0,950545***	S&P green	0,9551***
corr		0,390307***		0,4271***
alpha		0,060336*		0,0574*
beta	pair	0,796452***	pair	0,7943***

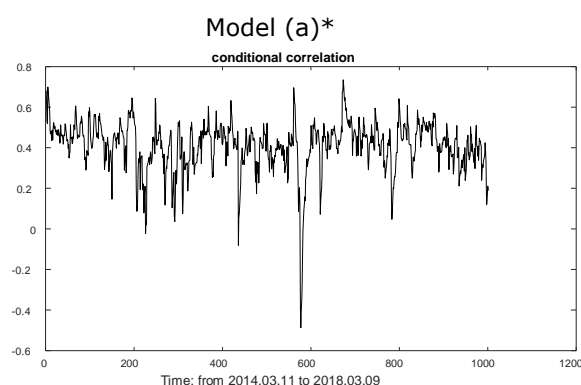
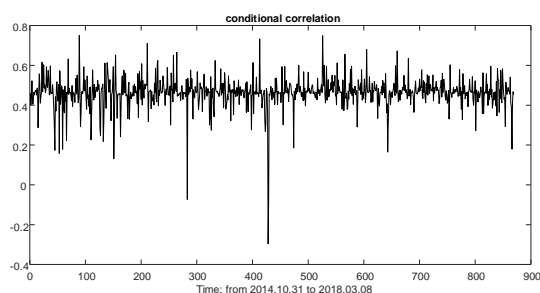
Source: own elaboration

Table 2 shows results of DCC model estimation. The conditional standard deviations for each individual series and the conditional correlations among the series were estimated using the DCC model as proposed by Engle (2002). Compared to other models, this model's flexibility in modeling time-varying conditional correlations has clear computational advantages as it allows for the estimation of very large correlation matrices (Pahm 2016).

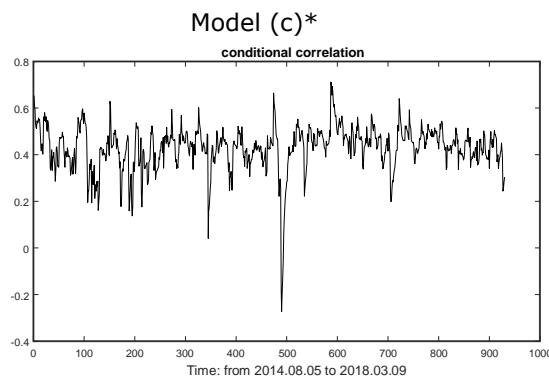
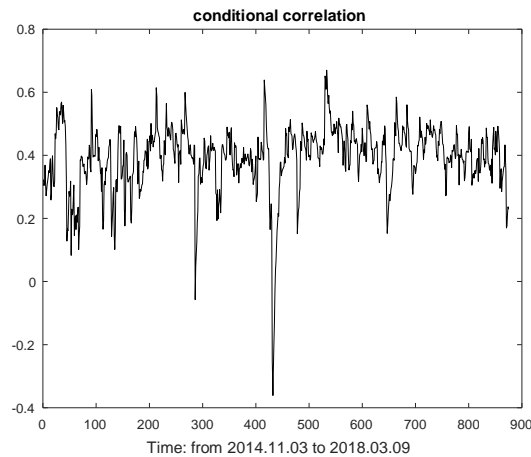
It indicates that majority of parameters for the indices are statistically significant. It also shows that conditional correlation average that is statistically significant for each pair is the highest for Bloomberg Barclays aggregate index and Bloomberg Barclays MSCI green bond index and the lowest for the pair of ICE BofAM green and Bloomberg Barclays aggregate index. Figure 1 plots daily formulation of conditional correlation.

Results show that conditional correlation of all green bond indices tends to circulate around 0,4 with minor periodical changes. That indicates that in case of every green bond index risk of investing is similar and rates of returns are positively correlated to conventional bonds indices. What is more we can initially state that shocks from conventional bonds markets are not being transmitted to green bond market. In times, for few days' periods, green bonds indices show negative correlation with conventional bonds, especially visible for each of the analysed indices during spring of 2016, presumably due to the Brexit vote, which was a big shock for the capital markets.

Figure 1 Conditional Correlation of Analyzed Indices



Model (b)*



Model (d)*

*Model (a) MSCI green, model (b) SOLGREEN, model (c) ICE BofAM Green, model (d) S&P Green
Source: own elaboration

While regression analysis for each green bond index shown that daily rates of return are explained with statistical significance by rates of return from previous day (-1 day) of the index and of the conventional bond index, only in the case of Solactive green bond index results were also depended on the rates of return from three days before, but not for two.

4 Discussion of results and conclusions

Our findings shed additional light at the previous research results in the scope of risk analysis of green bonds. Even though we chose similar method of analysis as other authors (Pahm 2016), the GARCH effect wasn't found in the majority of pairs of indices. It's worth noticing that green bonds indices are positively correlated with conventional bond indices and conditional correlation tends to maintain the average lever of 0,4 in the whole sample. However, they do not transfer violent changes from the conventional bond market. This combination of a positive general correlation with less sensitivity makes green bonds a very attractive instrument. Especially for investment funds that will be able to participate more in financing pro-ecological investments. From our research it stands out that changes in green bond indices rates of return do not impact changes in overall bond market indices. But this effect works in the opposite direction. This seems to be due to the much smaller size of the green bond market compared to traditional bonds. It also increases the attractiveness of these instruments, that apart from financial advantages can also play an important role in sustainable development of economies. We plan to further investigate the relationships due to the fact that GARCH analysis results weren't satisfactory.

References

Atkins, R. (2015). *Are green bonds a fair weather phenomenon?*. Retrieved from: <https://www.ft.com/content/af74028a-a708-11e4-8a71-00144feab7de>

- Bauwens, L., Laurent, S. and Rombouts, J. V. K. (2006). Multivariate GARCH Models: A Survey. *Journal of Applied Econometrics*, vol. 21(1), pp. 79–109.
- Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics*, vol. 31, pp. 307–327.
- Daszyńska-Żygadło, K., Marszałek, J. (2018). Green Bonds – Sustainable Finance Instruments. *Presentation on 21st International Scientific Conference Enterprise and Competitive Environment*. Brno: Mendel University.
- Engle, R. (2002). Dynamic Conditional Correlation. A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. *Journal of Business & Economic Statistics*, vol. 20(3), pp. 339–350.
- European Commission (2016). *Study on the potential of green bond finance for resource-efficient investments*. Retrieved from: <http://ec.europa.eu/environment/enveco/pdf/potential-green-bond.pdf>.
- Financing a Sustainable European Economy. Final Report. (2018). *High-Level Expert Group on Sustainable Finance*. Retrieved from: https://ec.europa.eu/info/sites/info/files/180131-sustainable-finance-final-report_en.pdf
- Glosten, L. R., Jagannathan, R., Runkle, D. E. (1993). On the Relation between the Expected Value and the Volatility of the Nominal Excess Return on Stock. *The Journal of Finance*, vol. XLVIII(5), pp.1779–1801.
- Kuna-Marszałek, A., Marszałek, J. (2017). Some considerations on the green bonds market development. In: *Proceedings of the 14th International Scientific Conference European Financial Systems 2017*. Brno: Masaryk University, pp. 458–465.
- Marszałek, J., Daszyńska-Żygadło, K. (2016). Charakterystyka globalnego rynku obligacji klimatycznych. *Finanse, Rynki Finansowe, Ubezpieczenia*, vol. 4/2016(82), pp. 945–955.
- Lee, C. W., Zhong, J. (2015). Financing and risk management of renewable energy projects with a hybrid bond. *Renewable Energy*, vol. 75, pp. 779–787.
- Mathews, J. A., Kidney, S. (2012). Financing climate-friendly energy development through bonds. *Development Southern Africa*, vol. 29(2), s. 337–349.
- Morel, R. (2012). Financing the transition to a green economy: their word is their (green) bond?. *Climate Brief*, vol. 14. Retrieved from: www.cdcclimat.com.
- Petrova, A. (2016). *Green Bonds: Lower Returns or Higher Responsibility?*. Nijmegen School of Management, Radboud University. Master Thesis
- Pham, L. (2016). Is it risky to go green? A volatility analysis of the green bond market. *Journal of Sustainable Finance & Investment*, vol. 6(4), pp. 263–291.
- Schroders (2015). *Green Bonds – A Primer. Talking Point*. Retrieved from: <http://www.schroders.com/hu/sysglobalassets/digital/insights/pdfs/green-bonds-a-primer.pdf>.
- Tang, A., Chiara, N., Taylor, J. E. (2012). Financing renewable energy infrastructure: Formulation, pricing and impact. *Energy Policy*, vol. 45, pp. 691–703.
- TD Economics (2013). *Green bonds: victory bonds for the environment. Special report*. Retrieved from: https://www.td.com/document/PDF/economics/special/GreenBonds_Canada.pdf
- Teräsvirta, T. (2009). An Introduction to Univariate GARCH Models. In: *Handbook of Financial Time Series*. Berlin: Springer, pp. 17–42.
- Tiselius, J., Kronqvist, M. (2015). *Drivers of Growth in the Corporate Green Bond Market*. Copenhagen: Copenhagen Business School. Master Thesis.
- Wu, M. W., Shen, C.H. (2013). Corporate social responsibility in the banking industry- Motives and financial performance. *Journal of Banking & Finance*, vol. 37.

Debt Literacy and Its Importance in the Czech Republic

Bohuslava Doláková

Masaryk University
Faculty of Economics and Administration, Department of Finance
Lipová 41 a, 602 00 Brno, The Czech Republic
E-mail: 175975@mail.muni.cz

Abstract: *This paper aims to show the importance of one part of financial literacy that causes most problems in the Czech Republic. According to the latest data, there is quite a lot of Czech overindebted – they borrowed too much money, lost jobs, found a very inconvenient loan, etc. Those people were not able to analyze their financial situation in the broad context of having a loan. As we know from the start of last big financial crisis risky loans (e.g., Mortgages) can cause a worldwide problem. In general people with lower levels of debt, literacy tends to transact in high-cost manners, incurring higher fees and using high-cost borrowing. Due to the New Consumer Credit Act from 2016, there was expected a change in the loan amounts and risk. It is too early to judge the impact of that act, but we can see a basic tendency that shows us people are still willing to go in debts. This makes debt literacy still very important as there are many overindebted people in the Czech Republic.*

Keywords: *financial literacy, debt literacy, indebtedness, mortgages*

JEL codes: *D11, D12, D14, D18, D91, G21*

1 Introduction

As there is a lot of attention to financial literacy in media during the last few years, people started to be more aware of the importance of this term. It has also been included into compulsory education in elementary schools and high schools too. We have to wait for the real results of this change in education, but we can see what is happening now in the financial market in the Czech Republic. We can use the data from the Ministry of Finance judging these abilities of the Czech Republic inhabitants. In 2010 and 2015, the Ministry of Finance measured the level of financial literacy of the adult population of the Czech Republic. This survey has become part of the global measurement together with the other dozens of countries of the Organization for Economic Co-operation and Development (OECD). The result was that Czech has in general “good awareness of financial products.” That seems to be very optimistic. But on the other hand, Almost a tenth of Czechs over the age of 15 have some property seizures. In total, there are 863,000 people and about 31,000 in the last year. What is a key problem in this area is called “debt literacy,” an important component of overall financial literacy? Debt literacy refers to the ability to make simple decisions regarding debt contracts, applying basic knowledge about interest compounding to everyday financial choices (Lusardi and Tufano, 2009). People can have quite good knowledge of financial products, where is the best basic private bank account, etc. But people can be completely unaware of what can happen when they finance their money deficiency by a loan. People with lower levels of debt literacy tend to transact in high-cost manners, incurring higher fees and using high-cost borrowing. Latest data about Czech indebtedness shows that some of the people are suffering to overindebtedness.

2 Methodology and Data

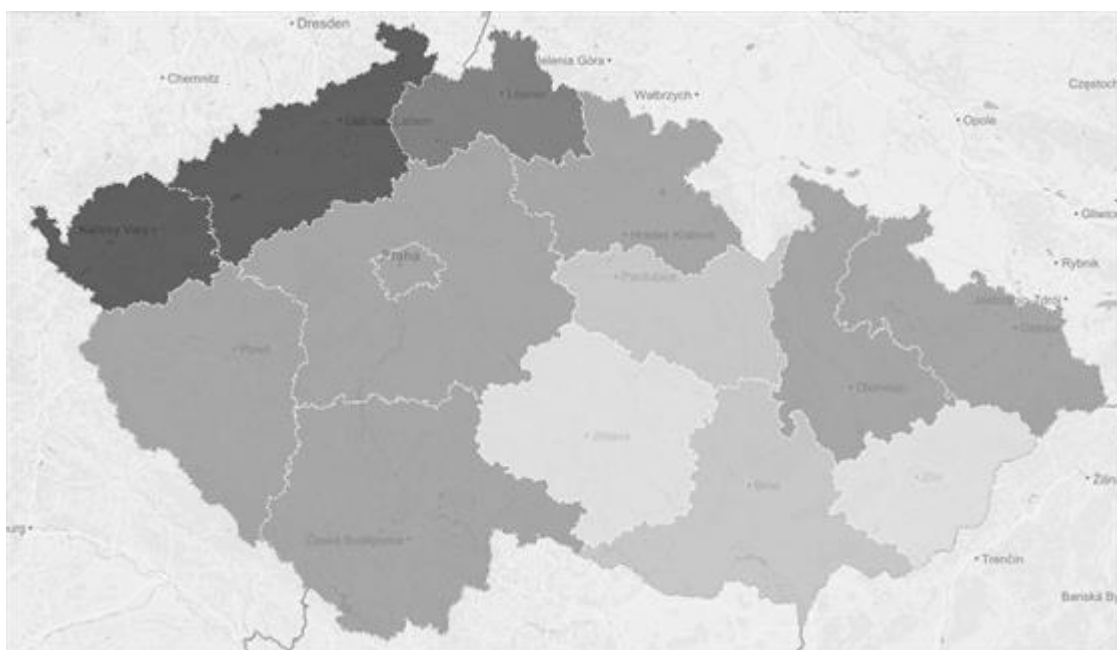
In this paper, there is used latest biggest financial literacy survey from the Ministry of Finance judging these abilities of the Czech Republic inhabitants. In this survey, there were a few questions regarding also debt literacy. Most important one was taken in this research.

The data about the debts, indebtedness, and overindebtedness were taken from quite new and very useful Map of Property Seizures which clearly show the distribution and seriousness of indebtedness in the Czech Republic.

Almost a tenth of Czechs and Czechs over 15 have some property seizures. In total, there are 863,000 people and about 31,000 in the last year. The number of people in property seizures grew 3.4 percent a year, despite record low unemployment and rising wages in the Czech Republic. Even higher salaries and the fact that people have jobs do not help them get out of the debt trap. Only interest and penalties are paid, not the principal of the loan. Half of the people owe less than 10,000 crowns. Most of the claimed sums are mainly costs. The average principal amounts to CZK 65,000. Three or more property seizures have almost half a million people. A total of 151,000 people over 15 have over ten property seizures. It's about 10,000 people between 18 and 29 years old and about 6,000 seniors over 65 years old. 90 percent of property seizures are unenforceable.

The amount of property seizures changes across the Czech Republic as we can see in Figure 1. There is an obvious connection to others social problems like unemployment but especially in such interconnected issues is the debt literacy crucial.

Figure 1 The Map of Property Seizure in the Czech Republic (2017)



Source: Map of Property Seizures <http://mapaexekuci.cz/index.php/mapa-2/>

Some property seizures encompassed by so-called unsuccessful property seizures for the entire duration of court bailiffs. This includes, for example, property seizures for which insolvency proceedings are conducted, so that the property seizure of the proceedings cannot be executed for that reason alone.

The number is so high, among other things, because there is no effective tool to stop these unsuccessful property seizures. It is necessary to simplify the termination of such property seizures even without the creditor's consent so that the whole system is cleared of these proceedings. After the start and implementation of this process, the number of both mandatory and some proceedings will be several times smaller.

The demotivating factor is that social benefits are calculated by net wages, without deduction of property seizure. People in property seizure often do not reach different types of support, though they are entitled to it because of the actual amount of income. In the Czech Republic, there is also no court fee for executing the property seizure, which, according to experts, leads to abuse of the system. The creditors, in their view, use the property seizure as a free repository of unpaid receivables.

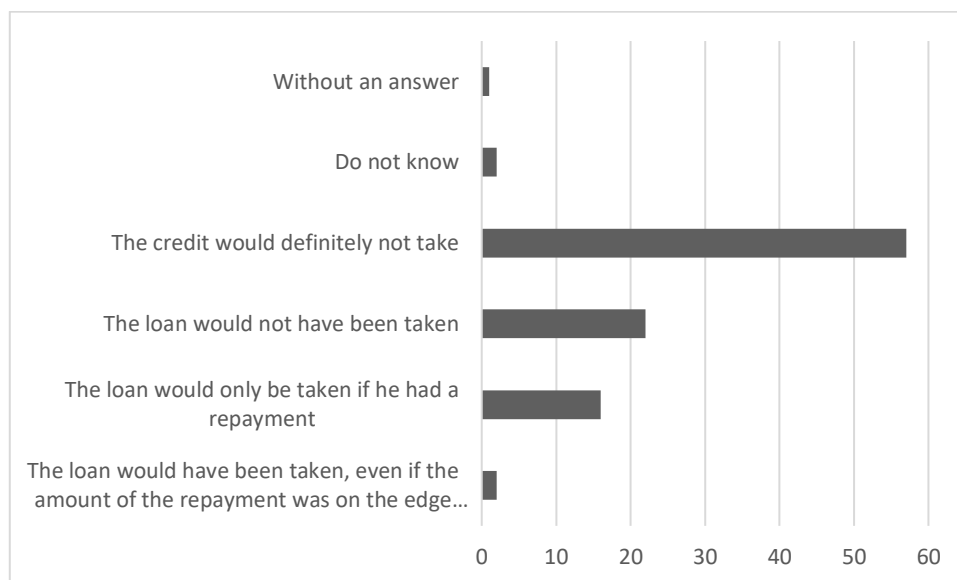
The negative development of the over-indebtedness situation mainly affects the debt cycle. It is proven that people in debt traps do not realize their full economic potential. There is also the negative impacts on their physical and mental health and the enormous burden

on the social system. An estimated two million property seizures of paralyzed Czechs - including family members - are not what the Czech Republic needs.

3 Results and Discussion

When we use the latest data from the Ministry of Finance most of the population (79%) would not take credit to pay for Christmas gifts as we can see in Figure 1.

Figure 2 Willingness to Take Credit Under Certain Conditions (n = 1000, data in%)

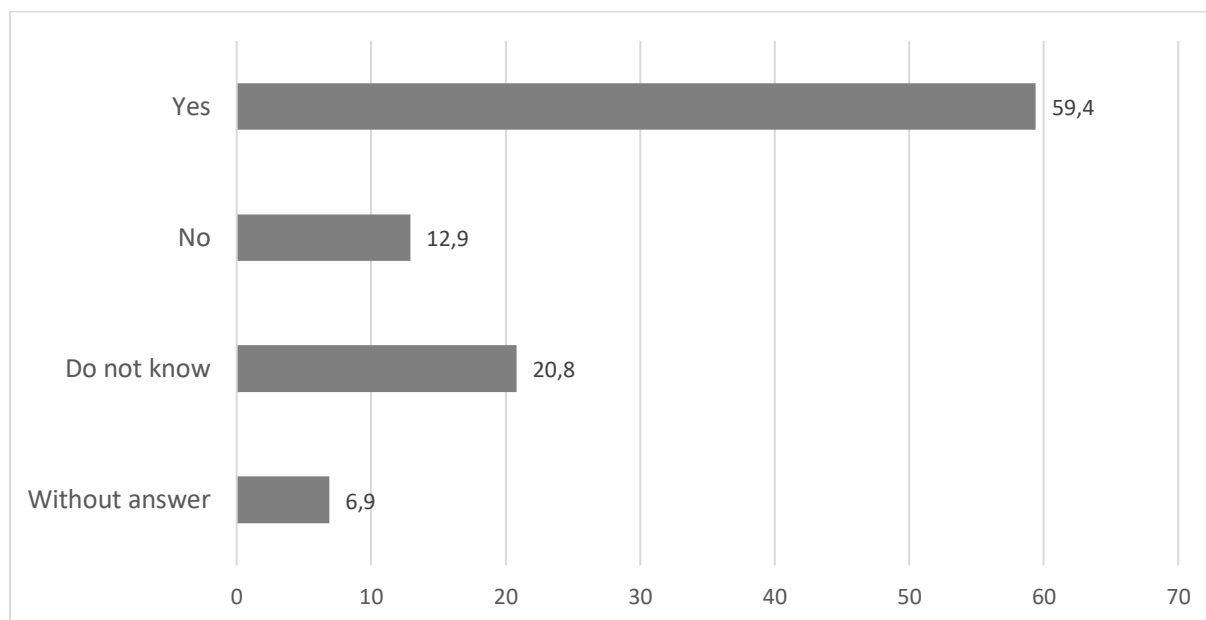


Source: Ministry of Finance (2016)

This seems to be very positive, but according to the latest data a lot of Czechs are indebted and suffer from overindebtedness.

Very important is the approach of people to the troubles with repaying. We can see in Figure 3 that most of the people (59,4%) would inform the creditor about late payment.

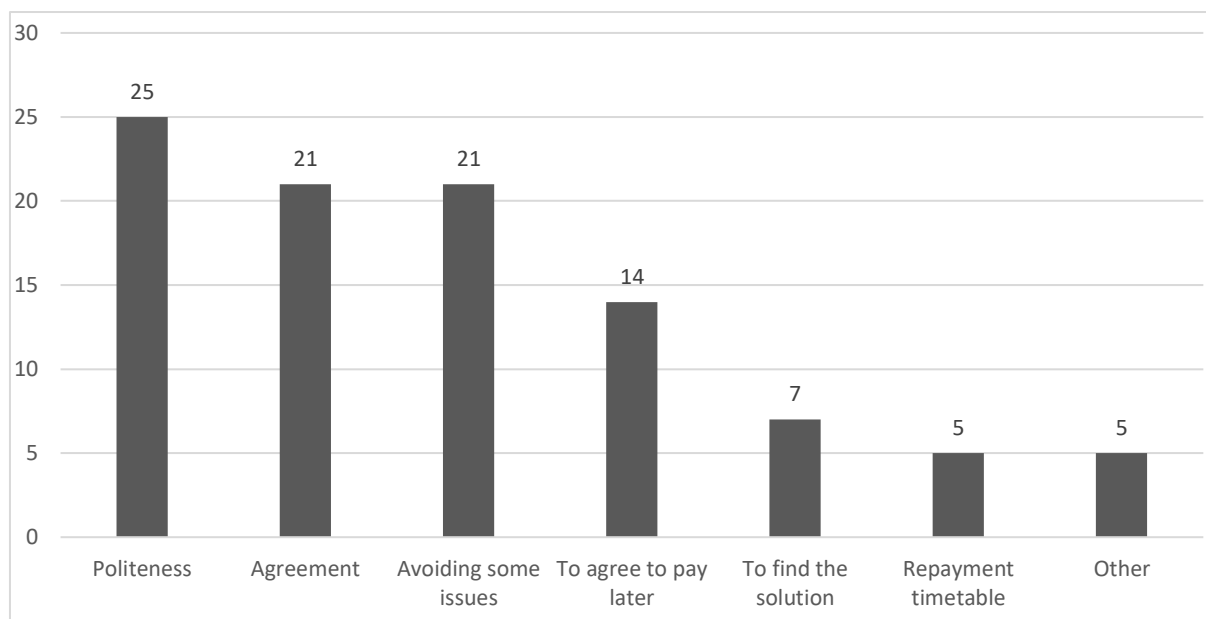
Figure 3 Informing of Creditor when Borrower Cannot Repay on Time (n = 1000, data in%)



Source: Ministry of Finance (2016)

The reasons why people would inform the creditor about late payment are in Figure 4 and it is just politeness, the effort to agree on what to do or just trying to avoid some big issues. People mostly want to protect themselves, and that is responsible.

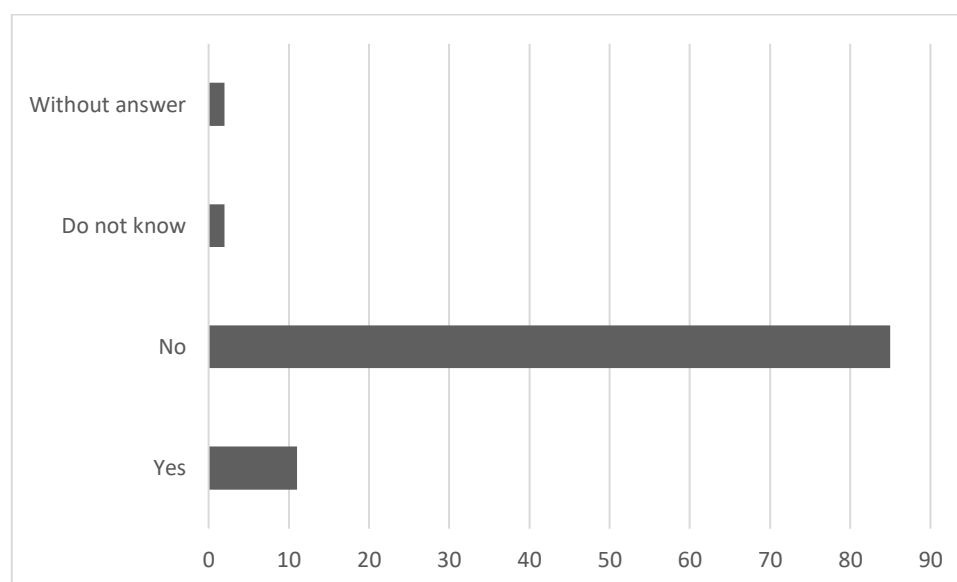
Figure 4 Why Inform the Creditor that Borrower Cannot Repay on Time (n = 1000, data in%)



Source: Ministry of Finance (2016)

The sample was also tested if they have had any repayment issues in the past – most of the people from the sample did not have any repayment issues as shows Figure 5.

Figure 5 Repayment Issues (data in%)



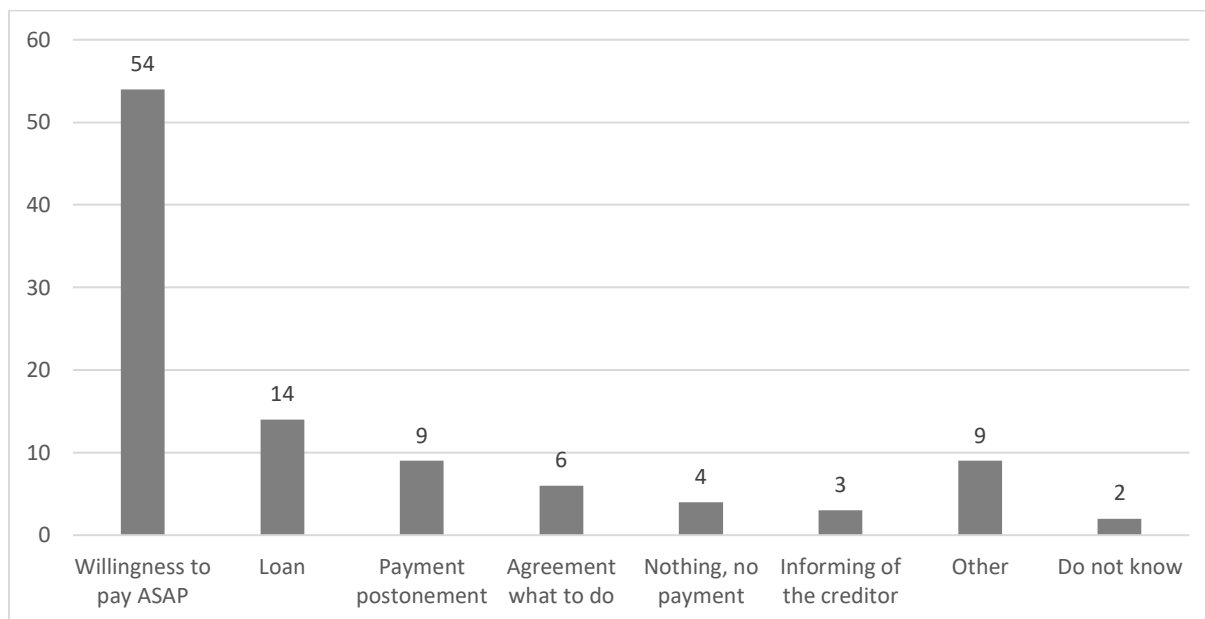
Source: Ministry of Finance (2016)

85% of people have no problems with timely payment of their obligations. In 2010 it was 80%. We can see progress here. People who have had problems with repayment in the past most often report that they have tried to pay the debt as quickly as possible (54%). 14% of people solved the problem with another loan. If these people got into the same situation now, 19% of them would be trying to debt what makes the fastest payment. 13% would have taken another loan. It is a visible change in the behavior – most of the people

tried to repay their debts, but in the future, they would do something else (22% of the people said "Other solution"). We can see people were responsible in the past, trying to be without debts but in the future, they would find some other, unknown solution.

In the past, most of the people (54%) wanted to pay the debt as soon as possible as it is clear in Figure 6. That is very rational and responsible solution.

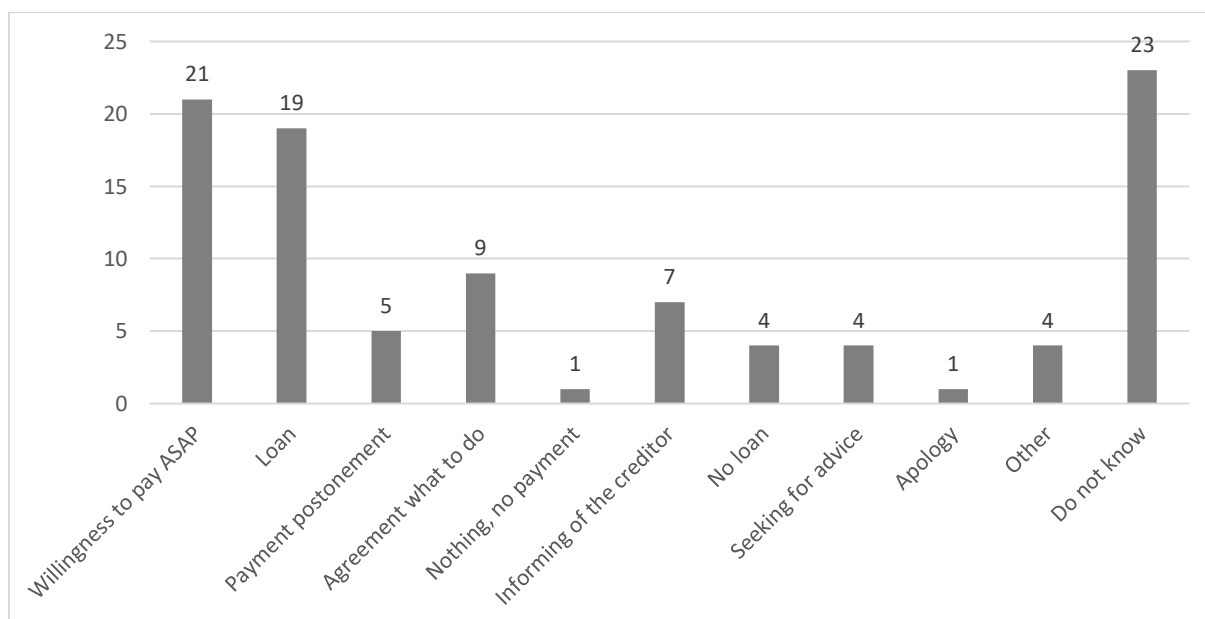
Figure 6 What Have Respondents Done in the Past (data in%)



Source: Ministry of Finance (2016)

What seems quite problematic is the reaction showed in Figure 7 of the people in theoretical repeating of that situation. Just 21% would pay as soon as possible again. Alarming is the fact that 23% of respondents did not know what to do in that situation. That means that they could probably just leave it and would not care about that issue – that is the worst possible solution because they can get very easily to property seizure.

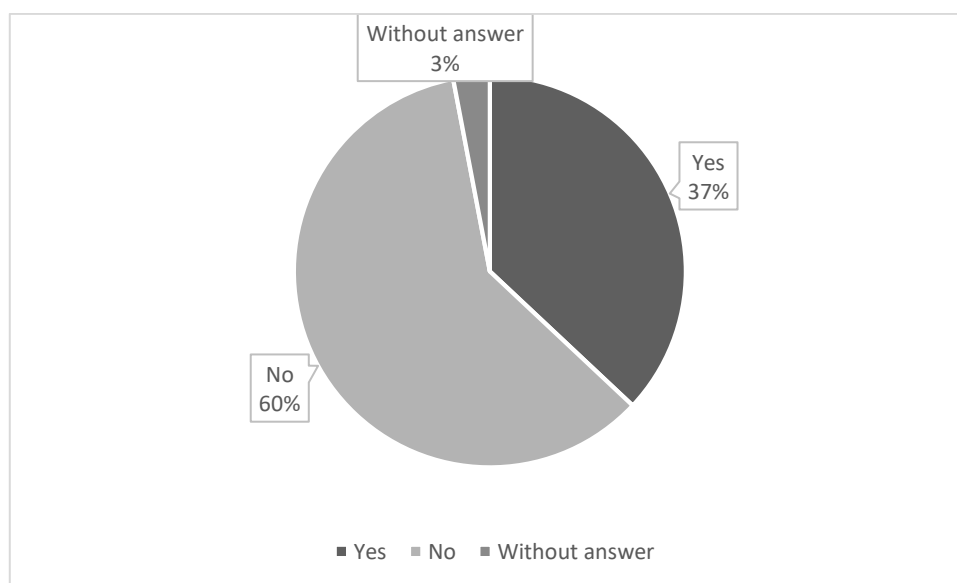
Figure 7 Theoretical Situation: Problems with Repayment (data in%)



Source: Ministry of Finance (2016)

For taking a loan, in general, is important to know some financial terms, especially annual cost percentage rate. From the sample, just 37% of people knew what it means as it is shown in Figure 8.

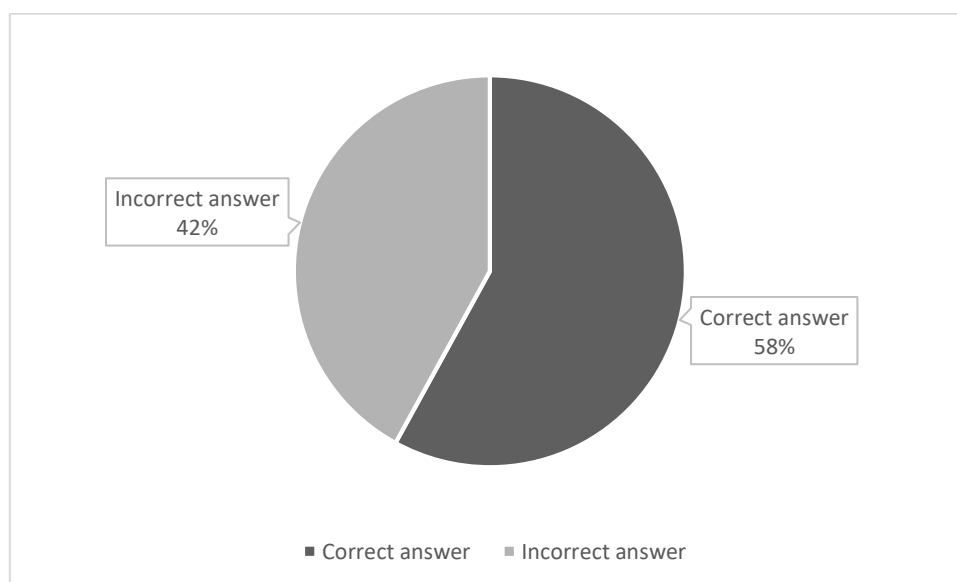
Figure 8 Knowledge of Annual Cost Percentage Rate (data in%)



Source: Ministry of Finance (2016)

Last Figure 9 shows that 58% of people from the sample knew what annual cost percentage rate means, so it is clear that a lot of people just do not know what can be hidden in a loan.

Figure 9 Definition of Annual Cost Percentage Rate (data in%)



Source: Ministry of Finance (2016)

The European Union has approached the regulation of the relationships of financial market participants with the consumer, in particular as regards the provision of loans earlier. These regulatory measures have been reflected in the Czech Republic, among other things, in the adoption in 2010 of Act No. 145/2010 Coll., On consumer credit. However, since December 2016, completely new legislation is in force, which is Act No. 257/2016 Coll., On Consumer Credit. This law covers all types of consumer credit, ranging from classic cash loans, credit cards, mortgage purchases to mortgages and other loans that are not covered by the

Consumer Credit Act (i.e., housing loans and so-called micro-loans). The Consumer Credit Act will thus in the future represent a comprehensive adjustment of the retail credit products distribution. Besides the product area, the law also unifies the institutional elements of regulation, among others, establishes uniform conditions for obtaining a business license in the credit sector, regulates the process of registration of regulated entities and supervising them, or defines uniform rules for the verification of expertise for persons acting with consumers.

There was an expected change in the increasing trend of property seizure because of overindebtedness 2016 due to the change in credit legislation effective from 1 December 2016. New Consumer Credit Act should make it more difficult to trick the consumers with inconvenient loans. We can compare the trend in (usually) the biggest loan that is taken, a mortgage.

Table 1 Number of New Mortgages in the Czech Republic

	2014	2015	2016	2017
Number of Mortgages	40 019	47 489	60 013	47 952

Source: Czech National Bank

The introduction of the Consumer Credit Act was fully reflected in mortgage lending procedures in 2017. The rules and procedures for granting mortgage loans are now much stricter and more transparent for clients. The two-fold increase of the CNB's two-week repo rate, together with the tightening of maximum LTV requirements, contributed to the reversal of the mortgage rate trend. However, the rise in interest rates last year was not dramatic.

Table 2 Total Household Debt (in CZK million), 30.4.2018

	Value	A year ago	Change
Consumption	287 074.00	272 470.70	5.36%
Accommodation	1 179 255.40	1 085 616.30	8.63%
Other	161 287.50	156 276.90	3.21%

Source: Czech National Bank

From Table 2 we can assume people still want to take on more loans. Now, there is a positive economic situation in the Czech Republic – as we have very low unemployment, minimal wages are rising and also other wages. In this situation is the debt literacy the most important. It should protect people who have taken a loan also against situations that can come in not such a positive economic situation (like an economic crisis).

4 Conclusions

This paper showed the importance of debt literacy as a special part of financial literacy that is crucial for the everyday life of the people. Financial literacy is important as a sum of knowledge, but it is different knowing how to save few Czech crowns by choosing a cheaper bank account than knowing how to protect yourself against the inability to pay your debts and what to do in that situation. People should have the skill of reason to debt. The debt should not be stigmatized but rationally drawn. Financial literacy is focused on the *price* of the loan (knowledge of financial mathematics), debt literacy is focused more on the *risk* of the loan (knowledge of the law consequences). Debt literate person should know the strategies of individual lenders, the different mechanisms that generate profit. The debt literate person should also be able to make sense of this knowledge in a responsible and responsible manner, and he/she should be able to recognize unfair practices. To be able to defend himself. Be able to find help in such a situation According to available and latest data; financial literacy is improving (when we compare big surveys from 2010 and 2015 made by Ministry of Finance). Debt literacy questions were answered very often in an

uncertain way – it is clear that people are struggling with this field of financial literacy. Data about rising property seizure levels suggest the same conclusions.

Acknowledgments

Support of Masaryk University within the project MUNI/A/0753/2017 “Behavioural, knowledge and economic aspects affecting the investment decision-making of entities” is gratefully acknowledged

References

Czech National Bank (2018). Data retrieved from: <http://www.cnb.cz>.

Lusardi, A., Tufano, P. (2009). Debt Literacy, Financial Experiences, and Overindebtedness. *NBER Working Paper*, n. 14808.

Map of Property Seizures (2018). Data retrieved from: <http://mapaexekuci.cz/index.php/mapa-2/>

Mika, A., Zumer, T. (2017). *Indebtedness in the EU: a drag or a catalyst for growth? Working paper series*. Retrieved from: <https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2118.en.pdf?42f482cdc484b293a3b7eb9997dfe1db>

Ministry of Finance (2016). *Měření úrovně finanční gramotnosti v roce 2015*. Retrieved from: <http://www.psfv.cz/cs/pro-odborniky/mereni-urovne-financni-gramotnosti/2015/mereni-urovne-financni-gramotnosti-2601>.

Turunen, E., Hiilamo, H. (2014). Health effects of indebtedness: a systematic review. *BMC Public Health*, vol. 14, p. 489. <http://doi.org/10.1186/1471-2458-14-489>.

Patterns of Currency Co-movement: Changes in the Impact of Global Currencies

Małgorzata Doman¹, Ryszard Doman²

¹ Poznań University of Economics and Business
Faculty of Informatics and Electronic Economy, Department of Applied Mathematics
Al. Niepodległości 10, 61-875 Poznań, Poland
E-mail: malgorzata.doman@ue.poznan.pl

² Adam Mickiewicz University in Poznań
Faculty of Mathematics and Computer Science, Laboratory of Financial Econometrics
Umultowska 87, 61-614 Poznań, Poland
E-mail: rydoman@amu.edu.pl

Abstract: *In the paper, we analyze the pattern of currency co-movement and document the impact of global currencies (USD, EUR, GBP, JPY) on selected minor ones. The investigation of linkages in the currency market is more complicated than it is in the case of capital markets. The reason for this is that the analysis of co-movement between two currencies requires the consideration of exchange rates which are always calculated against a third currency. The choice of this third currency certainly influences the results of comparison. There prevails an opinion that the pattern of the co-movement in the currency market is significantly driven by the relative influence of the global currencies, mostly the US dollar and the euro, but to some degree also by the British pound and the Japanese yen. In the paper, we examine the dynamics of strength and areas of this influence in the global currency market during the period 2011-2018. We pay special attention to the changes in the pattern caused by the European debt crisis and the UK decision about Brexit. The dynamics of the linkages is modeled by means of Markov regime switching copula models, and the strength of the linkages is described using dynamic Spearman's rho coefficients and the dynamic coefficients of tail dependence.*

Keywords: *exchange rates, global currencies, minor currencies, linkages, copula, Markov regime switching, tail dependence*

JEL codes: *G15, F31, C58, C32*

1 Introduction

In the paper, we show to what degree the selected minor currencies : AUD, CAD, CZK, CNY, INR, KRW, PLN, TRY, ZAR, representing different parts of the world, co-move with some major currencies (USD, EUR, GBP, JPY). To describe the dynamics of linkages in currency market, we model the dependence between exchange rate returns using dynamic copula models. This allows us to apply dependence measures which are better suited to quantify dependence in the case of nonelliptical joint conditional distributions and take into account dependence between extremes.

Currencies are an important class of assets. The mechanism of currency comovement is essential for diversifiability of currency exchange risk, which occurs during cross-border investments and trade. However, the analysis of co-movement in the case of currency markets is more complicated than it is, for example, in the case of capital market. The specificity of this problem is connected with the fact that examining the linkages between currencies, one has to use exchange rates which are always against some third currency (usually the American dollar or the euro). Naturally, the results of the analysis essentially depend on the choice of this third currency. Despite this difficulty and the fact that the exchange rate fluctuations are subject to different shocks, it seems to be possible for some currencies to find patterns of dependence indicating that they can co-move in a predictable way.

In the paper, we analyze the phenomenon of the co-movement of a minor currency with a major one, against other major. Our choice of the considered major currencies is done on

the basis of opinions by practitioners and researchers. It is clear that the USD and the euro are the most important, global currencies but the British pound and the Japanese yen play a significant role in the currency market as well (Angeloni *et al.*, 2011).

The concept of modeling currency co-movement we use in this paper goes back to Eun and Lai (2004) and Eun *et al.* (2013). The core of it is the following observation: if a minor currency XYZ is driven by a major one, say USD, then for an alternative major currency, say EUR, the exchange rates XYZ/EUR and USD/EUR, co-move very closely. To support this, the above mentioned authors use some linear models. Doman and Doman (2010, 2014, 2017) pointed out that the linear approach may be insufficient to describe the complex dynamics of dependence in the contemporary financial market, and used copulas to get a deeper insight into the structure of linkages.

In the first part of our analysis we determine the impact of the euro and the USD on each of the 11 considered currencies. In the second part, we show to what degree each of the minor currencies co-moves against the US dollar with the euro, British pound, and Japanese yen. The aim of the investigation is to describe the dynamics of dependence and possible changes in the pattern of linkages in the currency market taking into account the European debt crisis and the UK decision about Brexit.

2 Methodology and Data

The linear correlation still plays a role in financial theory. This tool for measuring dependence between financial returns is, however, appropriate only in the case of multivariate normal or, more general, elliptical distributions (e.g. multivariate Student's t distribution). Yet, observed asymmetries in one-dimensional marginal conditional distributions as well as in the conditional dependence structure imply that joint conditional distributions of financial returns mostly are not elliptical (see e.g. McNeil *et al.*, 2005). Because of that, modeling the returns using standard multivariate GARCH models (Bauwens *et al.*, 2006) may be unfounded. Instead, employing dynamic copula-based dependence models, which allow to model dependence structure separately from univariate marginal distributions, can be a better solution.

A bivariate copula is a function $C : [0,1] \times [0,1] \rightarrow [0,1]$ from the unit square to the unit interval that is a distribution function whose marginals are standard uniform (McNeil *et al.*, 2005). If X_1 and X_2 are random variables with joint distribution function F and marginal distributions F_1 and F_2 then, by a theorem by Sklar (1959), the following decomposition holds:

$$F(x, y) = C(F_1(x), F_2(y)). \quad (1)$$

Formula (1) shows that the joint distribution function splits into the marginals and a copula. Thus a copula can be seen as the dependence structure between X_1 and X_2 .

If F_1 and F_2 are continuous, the function C is given by the formula

$$C(u_1, u_2) = F(F_1^{-1}(u_1), F_2^{-1}(u_2)), \quad (2)$$

for $u, v \in [0,1]$, where $G^{-1}(u) = \inf\{x : G(x) \geq u\}$. In that case, C is called the copula of X_1 and X_2 or of F .

The simplest copula, which corresponds to independence, is defined by

$$C^\Pi(u, v) = uv. \quad (3)$$

In this paper we also apply the Gaussian (normal), Student, Joe-Clayton, and rotated Joe-Clayton copulas. They are defined by as follows:

$$C_\rho^{\text{Gauss}}(u_1, u_2) = \Phi_\rho(\Phi^{-1}(u_1), \Phi^{-1}(u_2)), \quad (4)$$

$$C_{\rho,\nu}^{Student}(u_1, u_2) = t_{\rho,\nu}(t_{\nu}^{-1}(u_1), t_{\nu}^{-1}(u_2)), \quad (5)$$

$$C_{\kappa,\gamma}^{J-C}(u_1, u_2) = 1 - \left(1 - ([1 - (1 - u_1)^\kappa]^{-\gamma} + [1 - (1 - u_2)^\kappa]^{-\gamma} - 1)^{-1/\gamma}\right)^{1/\kappa}, \quad (6)$$

$$C_{\kappa,\gamma}^{J-C-r90}(u_1, u_2) = u_2 - C_{\kappa,\gamma}^{J-C}(1 - u_1, u_2), \quad (7)$$

where in (4) Φ_ρ denotes the distribution function of a bivariate standardized Gaussian vector with the correlation coefficient ρ , and Φ stands for the distribution function of the standard normal distribution. Similarly, $t_{\rho,\nu}$ in (5) denotes the bivariate Student t distribution function with ν degrees of freedom and the correlation coefficient ρ , and t_ν stands for the univariate Student t distribution function with ν degrees of freedom. The parameters in the Joe-Clayton copula (6) satisfy the conditions: $\kappa \geq 1$, $\gamma > 0$. This copula, also called the BB7 (Joe, 1997), is capable of modeling asymmetric dependence structures and, in particular, asymmetric dependence between extreme events. The rotated Joe-Clayton copula is a version of the Joe-Clayton copula that models negative dependence.

Spearman's rho for variables X_1 and X_2 with marginal distribution functions F_1 and F_2 can be defined as

$$\rho_s(X_1, X_2) = \rho(F_1(X_1), F_2(X_2)), \quad (8)$$

where ρ denotes the usual Pearson correlation. This is a dependence measure, which depends solely on a copula linking X_1 and X_2 . When C is the copula of X_1 and X_2 , then

$$\rho_s(X_1, X_2) = \rho_C = 12 \iint_{[0,1]^2} C(u_1, u_2) du_1 du_2 \quad (9)$$

(Nelsen, 2006). From the definition of a copula it follows that if C_1 and C_2 are copulas then for any $0 \leq \alpha \leq 1$ the function $C = \alpha C_1 + (1 - \alpha)C_2$ is also a copula. Thus, formula (9) implies that in such a situation the following holds for the corresponding Spearman's rhos:

$$\rho_C = \alpha \rho_{C_1} + (1 - \alpha) \rho_{C_2}. \quad (10)$$

We model the joint conditional distribution of bivariate returns assuming that there can be three regimes in each of which a fixed copula describes the dependence structure, and the regime switching is driven by some Markov chain (cf. Garcia and Tsafack, 2011). Thus, in the applied Markov switching copula (MSC) model the conditional distribution of the vector $\mathbf{r}_t = (r_{1,t}, r_{2,t})$, $t = 1, K, T$, has the following form

$$\mathbf{r}_t | \Omega_{t-1} \sim C_{S_t}(F_{1,t}(\cdot), F_{2,t}(\cdot) | \Omega_{t-1}), \quad (11)$$

where Ω_t denotes the up to time t information set, $r_{i,t} | \Omega_{t-1} \sim F_{i,t}$, $i = 1, 2$, and S_t is a homogeneous Markov chain with state space $\{1, 2, 3\}$. The parameters of the MSC model (i.e. those of the univariate ARMA-GARCH models for the marginal distributions, of the copulas C_1 , C_2 and C_3 , and the transition probabilities $p_{ij} = P(S_t = j | S_{t-1} = i)$) are estimated by the maximum likelihood method. The main by-products of the estimation, which are used to construct time-varying conditional dependence measures, are the conditional probabilities $P(S_t = j | \Omega_{t-1})$, $P(S_t = j | \Omega_t)$ and $P(S_t = j | \Omega_T)$ (Hamilton, 1994).

We analyze the dynamics and strength of the impact of a major currency on a minor one using the idea proposed by Eun and Lai (2004). This idea consists in an observation that when a minor currency XYZ is driven, for instance, by the US dollar then the exchange XYZ/EUR and USD/EUR co-move very closely. In the opposite case, i.e. when the XYZ is influenced by the euro, the exchange rates XYZ/USD and EUR/USD show strong

interdependence. The aim of our analysis is to determine to what degree each of the considered minor currencies co-moves with a major one against another major. The first part of the analysis concerns the competitive influence of the US dollar and the euro on the currency market. In the second part, we show to what degree each of the considered minor currencies co-moves with the euro, British pound, and Japanese yen, examining the corresponding exchange rates against the US dollar.

The analysis presented in the paper is based on the percentage daily logarithmic returns of exchange rates. The period under scrutiny is from January 3, 2011 to March 30, 2018 (1878 observations). The steps of the analysis were as follows. First, to each of the investigated return series a univariate ARMA-GARCH model was carefully fitted. It is worth mentioning that in the case of the exchange rates of minor currencies against major ones the standardized innovations of fitted models mainly followed skewed Student's t distributions (Laurent, 2013) with diverse degrees of freedom. This precluded from using standard multivariate GARCH models, and justified applying dynamic copulas.

The MSC models were fitted to the transformed ARMA-GARCH standardized residuals by the maximum likelihood method. We tried to apply at most 3 regimes, and copulas from various families. Our final choice is the effect of taking into account the obtained values of the information criteria and, where applicable, the results of the performed likelihood ratio tests. All the calculations were done using G@RCH 7.0 package (Laurent 2009) and the MATLAB software. Due to space limitations, we do not present here the obtained parameter estimates. Instead, we show estimates for the dynamic smoothed Spearman's rho coefficients. They were calculated by the formula

$$\rho_t = \sum_{i=1}^3 \rho(i) P(S_t = i | \Omega_T), \quad (12)$$

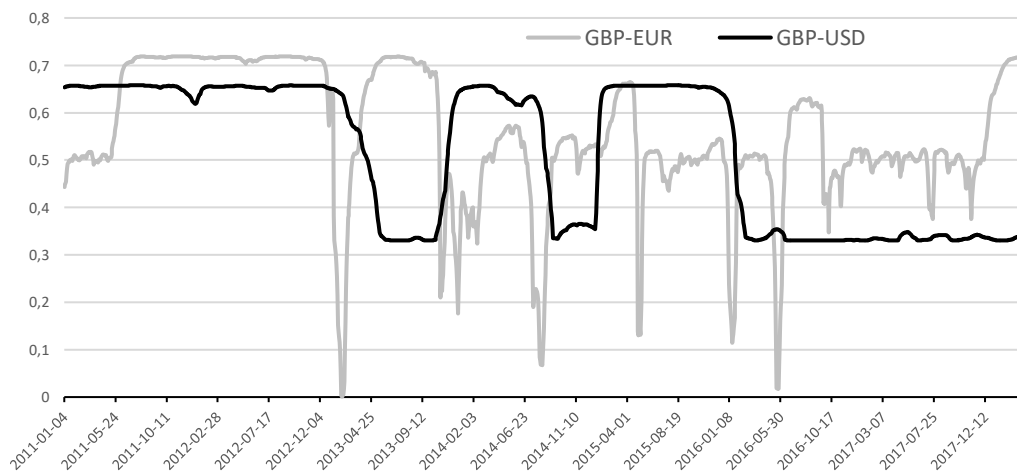
where $\rho(i)$ is Spearman's rho for the copula prevailing in regime i .

3 Results and Discussion

Eun and Lai (2004) consider trade pattern, financial integration, colonial heritage and geographical location to be the main factors determining the pattern of currency co-movement. This allowed us to formulate some conjectures concerning the future results. For example, we expected that the PLN, CZK, TRY and GBP were linked with the euro; the CAD, KRW and JPY with the USD; and the INR and ZAR with the GBP.

Although in the second part of our analysis we consider the GBP and JPY as major currencies, the knowledge about their co-movement with the USD and euro is necessary to understand their impact on minor currencies. Figures 1 and 2 show the estimates of dynamics Spearman's rhos for the GBP and JPY, respectively.

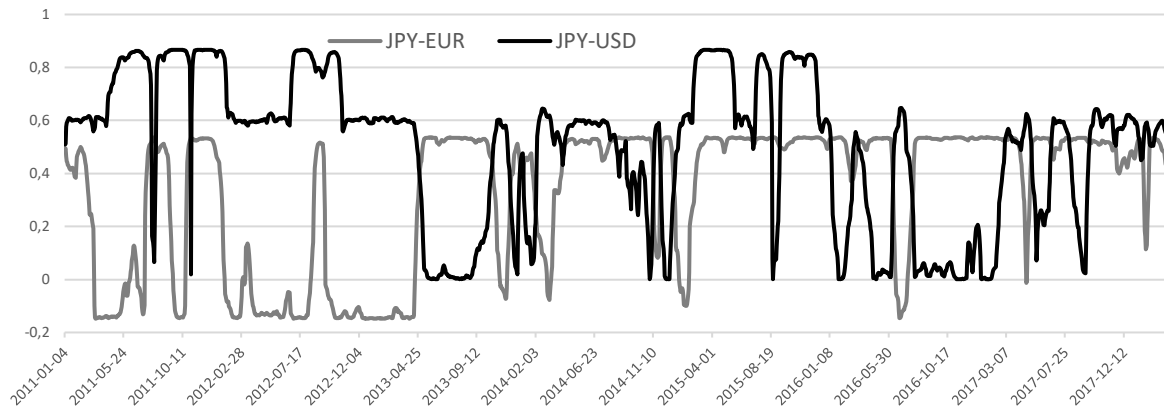
Figure 1 Dynamic Spearman's Rhos for (GBP/USD, EUR/USD) and (GBP/EUR, USD/EUR)



Source: authors

The plots presented in Figure 1 show that the British pound alternately co-moves with the euro and US dollar. This supports a common opinion that the GBP should be considered to be one of major currencies. Another pattern is visible for the Japanese yen (Figure 2) – high values of Spearman's rho indicate strong linkages with the USD.

Figure 2 Dynamic Spearman's Rhos for (GBP/USD, EUR/USD) and (GBP/EUR, USD/EUR)



Source: authors

Table 3 Co-movement of Minor Currencies with the USD against the EUR and with the EUR against the USD (copulas: N = *Gauss*, t = *Student*, PI = Π , JC = *Joe-Clayton*)

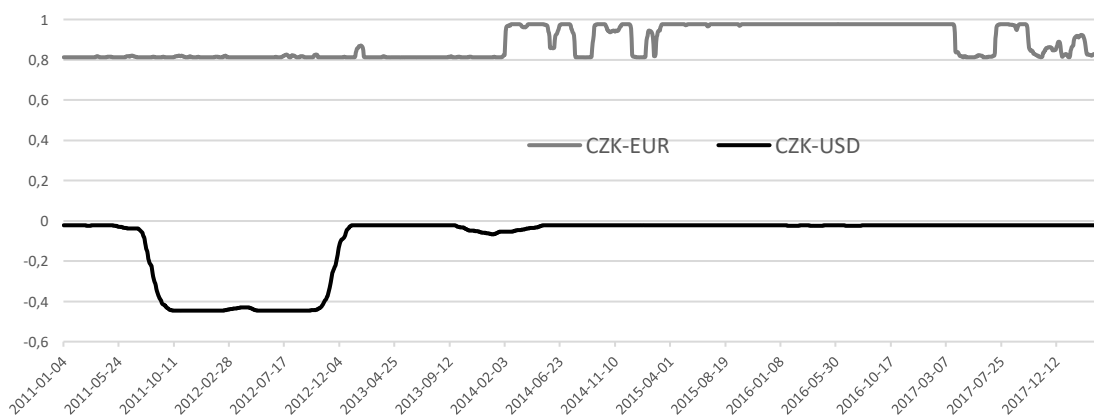
Minor currency	with the USD against the EUR	with the EUR against the USD
GBP	Spearman's rho from 0.3302 to 0.6576; strong dependence (rhos about 0.65) until the end of 2015 with short periods of weaker (0.33) linkages, from 2016 stable level of Spearman's rho about 0.3. Model: N-t	Spearman's rho from 0.0011 to 0.7187; strong dynamics of dependence driven by market events; occasionally no linkages. Model: N-N-PI
JPY	Spearman's rho from 0 to 0.8666; during almost all of the analysed period strong linkages (rho greater than 0.6), very short periods of independence. Model: N-N-PI	Spearman's rho from 0.1477 to 0.5362; negative dependence during the European debt crisis and about the British referendum concerning Brexit ; from 2014 mostly stable level of Spearman's rho (about 0.5). Model: N-t
AUD	Spearman's rho from 0.1268 to 0.4914; weak linkages at the beginning of the analyzed period (until August 2012) and during the British referendum concerning Brexit. Model: N-t	Spearman's rho from 0.0006 to 0.6734; the highest values at the beginning of the analyzed period (until September 2012) and during the British referendum concerning Brexit. Model: N-N-PI
CAD	Spearman's rho from 0.3427 to 0.6584; an increase in the strength of linkages in April 2012, in 2011 weak linkages (probably the remnants of the subprime mortgage crisis). Model: N-t	Spearman's rho from 0.1642 to 0.6248; generally weak linkages (rhos about 0.2) with short periods of increase, among others, after the British referendum concerning Brexit. Model: N-N
CNY	Spearman's rho from 0.0018 to 0.4077; strong dynamics of linkages with intensive fluctuations.	Spearman's rho from 0 to 0.5191; stable level of Spearman's rho until June 2012, then strong dynamics of linkages with intensive fluctuations.

	Model: PI-JC	Model: N-N-PI
CZK	Spearman's rho from -0.4462 to -0.220, i.e. negative dependence during all the considered period. Model: N-JC_r90	Spearman's rho from 0.8119 to 0.9778, the highest values during the period 2015-2017. Model: N-t
INR	Spearman's rho from 0.0036 to 0.4295; regular oscillations of Spearman's rho during all the considered period (March 2014-March 2016). Model: N-PI	Spearman's rho from -0.2023 to 0.1182; very weak positive dependence or negative dependence (April 2014-April 2015, June 2015, February 2016). Model: N-C
KRW	Spearman's rho from 0.0002 to 0.2285; stronger linkages until May 2012, and then from May to August 2015. Model: N-PI	Spearman's rho 0.0588; almost independence. Model: N
PLN	Spearman's rho from -0.4764 to 0.1429; regular oscillation. Model: N-N-JC	Spearman's rho from 0.5479 to 0.8523; Stable connection with regular oscillation. Model: N-N
TRY	Spearman's rho from 0.2903 to 0.6908; short periods with stronger linkages (in 2012-2013; 2015, 2016, 2018). Model: N-N	Spearman's rho from 0.1089 to 0.5993; strong fluctuations – sensitivity on markets events. Model: N-N-JC
ZAR	Spearman's rho from 0 to 0.3055; Weak dependence or independence (2011-2012, 2017) Model: C-JC	Spearman's rho from 0.1942 to 0.6961 The strongest linkages from May 2011 to April 2012; regular oscillations of Spearman's rho during the remaining part of the period. Model: N-N-JC

Source: authors

In Figure 3 we present the results for the Czech koruna. There is no surprise, the koruna is linked with the euro and exhibits no dependence with the US dollar. In the case of linkages with the euro, the highest values of Spearman's rho occur during the period of the exchange rate commitment, i.e. 7.11.2013-6.04.2017 (Noerr 2017). An interesting thing is that in the fitted 2-regime MSC model the second regime is driven by the JC90 copula. This means that there appeared negative dependence in extreme events between the USD and Czech koruna against the euro.

Figure 3 Dynamic Spearman's Rhos for (CZK/USD, EUR/USD) and (CZK/EUR, USD/EUR)



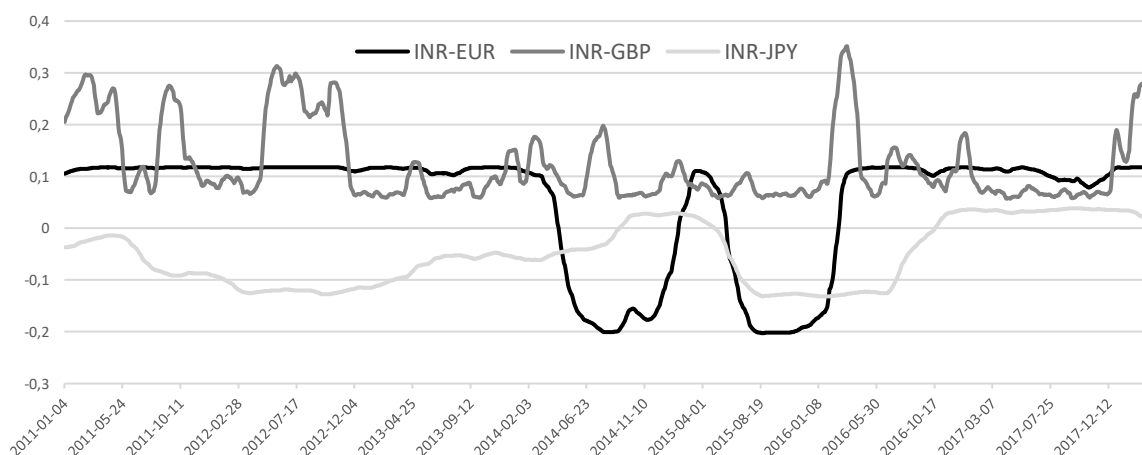
Source: authors

The results of the first part of our analysis indicate that the CZK, PLN, TRY and ZAR belong to the euro area of influence. The impact of the USD on the CAD, CNY, INR, KRW and JPY is clear.

The aim of the second part of the analysis is to determine with which of the three major currencies (EUR, GBP, JPY) each of the considered minor currencies co-moves against the US dollar. In Figure 4 we present the results for the Indian rupee. One can see that the linkages with the GBP are the strongest, though the observed values of Spearman's rho are not very high (0.06-0.35). The plots presented in Figure 5 combined with the results in Table 1 clearly indicate that the Polish zloty strongly co-moves with the euro.

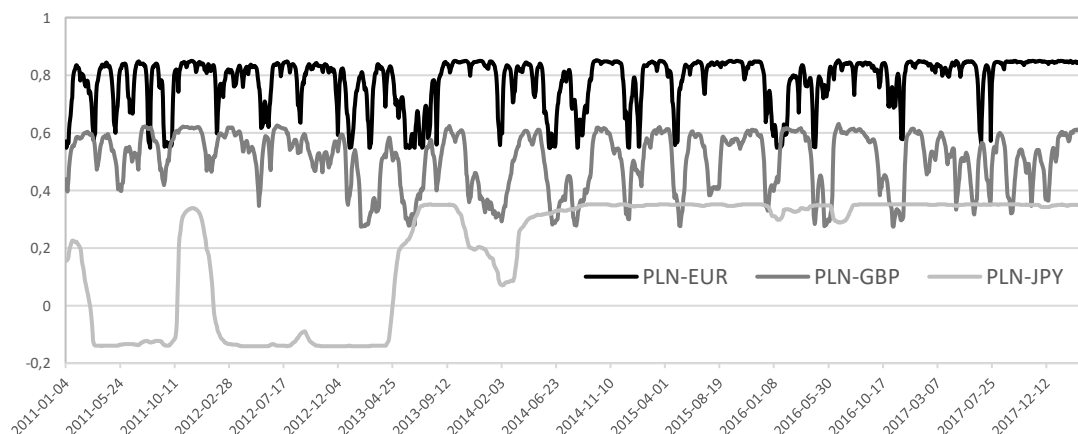
Our results show that, considering co-movement against the USD, we can divide the investigated minor currencies into four groups. The directions of movements of the CZK, PLN, TRY against the USD are concordant with the behavior of the euro. The AUD and CAD co-move with the euro and GBP with similar intensity. The INR and ZAR seem to be connected with the GBP. Surprisingly, we do not observe any significant linkages of the analyzed currencies with the JPY. The KRW and CNY are not linked with any of major currencies.

Figure 4 Dynamic Spearman's Rhos for (INR/USD, EUR/USD), (INR/USD, GBP/USD) and (INR/USD, JPY/USD)



Source: authors

Figure 5 Dynamic Spearman's Rhos for (PLN/USD, EUR/USD), (PLN /USD, GBP/USD) and (PLN /USD, JPY/USD)



Source: authors

4 Conclusions

The investigation of linkages in the currency market is more complicated than it is in the capital market case. The reason is that the analysis of the co-movement of two currencies requires the consideration of exchange rates which are always calculated against a third currency. The choice of this third currency certainly influences the results of comparison. In the paper, we showed to what degree some selected minor currencies representing different parts of the world (AUD, CAD, CZK, CNY, INR, KRW, PLN, TRY, ZAR) co-move with some major currencies (USD, EUR, GBP, JPY). We describe the dynamics of linkages in the currency market by means of Markov switching copula models. In the first part of our analysis we determine the impact of the euro and USD on each of the 11 considered currencies. For the CZK, PLN, TRY and ZAR, the dominating currency is the euro, and the remaining currencies are in the USD area of influence. The second group of our results deals with the co-movement against the US dollar. We find that the CZK, PLN and TRY co-move with the euro against the USD, and the AUD and CAD co-move with the euro and GBP with similar intensity. The INR and ZAR seem to be connected with the GBP. We did not observe any significant linkages of the analyzed currencies with the JPY. The dynamics of linkages is sensitive on market events. The impact of the British decision concerning Brexit is visible but short-lived.

References

- Angeloni, I., Bénassy-Quéré, A., Carton, B., Darvas, Z., Destais, C., Pisani-Ferry, J., Sapir, A., Vallée, S. (2011). *Global currencies for tomorrow: A European perspective*. Brussels: Breugel.
- Doman, M., Doman, R. (2010). Patterns of currency co-movement: the USD and the EUR areas of influence. In: Prachalias, C., ed., *Proceedings of 7th International Conference on Applied Financial Economics*. Athens: National and Kapodistrian University of Athens, pp. 384-393.
- Doman, M., Doman, R. (2014). Dynamic Linkages in the Pairs (GBP/EUR, USD/EUR) and (GBP/USD, EUR/USD): How Do They Change During a Day? *Central European Journal of Economic Modelling and Econometrics*, vol. 6(1), pp. 33-56.
- Doman, M., Doman, R. (2017). The impact of the US dollar and the euro on currencies in Europe and Asia. In: Hic Gencer, A., Sözen, I., Sari, S., ed., *Eurasian Economies in Transition*. Newcastle upon Tyne: Cambridge Scholars Publishing, pp. 166-182.
- Eun, C. S., Lai S. S. (2004). Currency Comovement. *Georgia Institute of Technology Working Paper*.
- Eun C., Lai S., Lee K. (2013). Exchange Rates Comovement. *KAIST Business School Working Paper Series*, KCB-WP-2013-020.
- Garcia, R., Tsafack, G. (2011). Dependence structure and extreme comovements in international equity and bond markets. *Journal of Banking and Finance*, vol. 35(8), pp. 1954-1970.
- Hamilton, J. D. (1994). *Time Series Analysis*. Princeton: Princeton University Press.
- Joe, H. (1997). *Multivariate Models and Dependence Concepts*. London: Chapman and Hall.
- Laurent S. (2013). *Estimating and Forecasting ARCH Models Using G@RCH 7*. London: Timberlake Consultants.
- McNeil, A. J., Frey, A., Embrechts, P. (2005). *Quantitative Risk Management*. Princeton: Princeton University Press.
- Nelsen R. B. (2006). *An Introduction to Copulas*, 2nd ed. New York: Springer.
- Noerr (2017). *Czech Republic: Czech exit from the exchange rate commitment*. Retrieved from: <https://www.noerr.com/en/newsroom/News/czech-republic-czech-exit-from-the-exchange-rate-commitment.aspx>
- Sklar, A. (1959). Fonctions de répartition à n dimensions et leurs marges. *Publications de l'Institut Statistique de l'Université de Paris*, vol. 8, pp. 229-231.

Motor Vehicle Insurance in SMEs

Michal Fabuš¹, Viktória Čejková²

¹ School of economics and management in public administration in Bratislava
Department of economics and finance
Furdekova 16, SK – 851 04 Bratislava, Slovakia
E-mail: michal.fabus@vsemvs.sk

² School of economics and management in public administration in Bratislava
Department of economics and finance
Furdekova 16, SK – 851 04 Bratislava, Slovakia
E-mail: viktorcia.cejkova@vsemvs.sk

Abstract: *In the present paper we deal with the insurance of motor vehicles in small and medium-sized enterprises. We deal with legal aspects of insurance of motor vehicles, we characterize this type of insurance in the Slovak Republic. We analyze in more detail the compulsory contractual liability insurance for motor vehicle damage, as well as emergency insurance. We analyze the insurance of motor vehicles in the selected small business. In the last part, we deal with the development of motor vehicle insurance, problems in motor vehicle insurance and trends in motor vehicle insurance in the Slovak Republic.*

Keywords: *insurance, motor insurance, motor vehicle operation, compulsory contractual liability insurance, white card, green card*

JEL codes: *G 22*

1 Introduction

Every entrepreneur works with different risks. The risk arising from business activities can be eliminated or reduced to an economically acceptable rate by applying appropriate measures. The negative consequences of risks can be reduced by the entrepreneur by transferring them to another entity operating on the financial market - to a commercial insurance company. One of the most frequently encountered risks that threatens small and medium-sized businesses is the risk of damage to, destruction or theft of a motor vehicle and damage caused by the operation of a motor vehicle. Therefore, this paper deal with the insurance of motor vehicles in small and medium-sized enterprises.

The market economy system (market economy) is a system in which the solution of the basic questions of the organization of the economy is in the hands of individuals. These decisions are made based on a price mechanism and the interaction of demand and supply. The market economy is based on a system of free enterprise and free competition (Lisý, 2016).

At present, we understand insurance as a normal part of modern life. Without insurance, many areas of today's society and economy could not function properly. The insurance industry provides coverage of economic, climatic, technological, political and demographic hazards, making it easier for individuals and businesses to live in business, innovation and development. A dynamically developing insurance market positively affects the economic growth (Grmanová, 2015).

Importance of insurance can be assessed both in terms of insured business and citizens, as well as in terms of the whole society (Grmanová, Hošták, 2016). For businesses, insurance stabilizes their economic level and affects the economic outcome. It allows the distribution of costs for business entities and the reduction of large costs in case of unforeseen events. In the event of adverse events that are the subject of insurance, the losses of business entities will moderate and thus stabilize their economic situation (Čejková, 2013).

2 Methodology and Data

In our papers, we characterize the insurance, its significance and its breakdown, as well as the insurance products of the obligatory contractual liability insurance for the damage caused by the operation of the motor vehicle, and the accident insurance of the vehicle. We will highlight the development of motor insurance in a small enterprise, and their application in this insurance in the selected SME. Also, problems and trends related to insurance of motor vehicles and the anticipated development of insurance of motor vehicles in the Slovak Republic. At the same time, we emphasize the importance of motor vehicle insurance for small and medium-sized businesses, such as mandatory contractual liability insurance and the possibility of reducing economic loss in the event of motor vehicle theft or the impact of a motor vehicle caused by the businessman himself.

The methods of description, analysis, synthesis, deduction and comparison will be applied.

Based on data from selected private company on the development of premiums and claims paid and received in the period of 2008-2017 we analyze economic outcomes of motor vehicle insurance. According the data we can see the difference between paid premiums and received claims, which are positive from economics point of view.

3 Results and Discussion

Commercial insurance companies in the Slovak Republic provide insurance for motor vehicles that cover several risks - the risks associated with the operation of the motor vehicle and with the ownership of the motor vehicle. Damage caused by the operation of a motor vehicle covers compulsory contractual liability insurance for damage caused by the operation of a motor vehicle. Damage that arises on a motor vehicle, his theft is covered by accident insurance, also called KASKO insurance.

A motor vehicle may cause damage while operating, and at the same time damage to the motor vehicle may occur. In the case of insurance against risks related to the motor vehicle, the following insurances were incurred: compulsory contractual liability insurance for damage caused by the operation of a motor vehicle, and accident insurance - KASKO.

In terms of insurance classification, we may be required to make compulsory liability insurance for damage caused by the operation of a motor vehicle, also referred to as "compulsory contractual insurance" or "CCI". Under Section 822 of the Civil Code of Liability Insurance, the insured person has the right to insure the insurer, in the event of a claim, to compensate him under the insurance conditions for damage to which the insured person is liable. The insurer pays the refund to the injured party; however, the injured party has the right to be paid by the insurer, unless otherwise provided in the special regulations.

Obligatory contractual insurance is legislatively regulated in the Act of the National Council of the Slovak Republic no. 381/2001 Coll. on compulsory contractual insurance for liability for damage caused by the operation of a motor vehicle and on the amendment and supplementation of certain laws.

The motor vehicle is a self-propelled vehicle as well as a non-self-propelled vehicle for which a vehicle registration certificate, vehicle technical certificate or a similar license is issued.

The obligation to conclude an insurance policy in a domestic motor vehicle is the one who is the holder of a motor vehicle registered in the vehicle or the person who is registered in the vehicle documents as the person to whom the motor vehicle has been transferred in other cases the owner of the motor vehicle or its operators. If a rental contract is concluded on a motor vehicle with the right to purchase a leased property, the lessee has the obligation to conclude the insurance contract. Liability insurance applies to anyone who is responsible for the damage caused by the operation of the motor vehicle covered by the insurance contract.

The insured has the right to insure liability for the insurer to compensate for the damaged and proven claims, namely: damage to health and the cost of death, damage caused by damage, destruction, theft or loss of the expense incurred by the legal representation in the exercise of claim, lost profits and others.

Compulsory contractual insurance covers the liability of the insured for the territory of the Slovak Republic and the territory of the states with which the Slovak Republic has concluded an agreement on the mutual settlement of claims for damages. These countries are listed in the green card. An insurer for compulsory contractual insurance issues the insured insurance certificate (white card) and a green card. The white card proves the liability insurance in the territory of the Slovak Republic, the green card is an international document on the validity of the insurance abroad. In countries not listed in the green card, insurance is required when entering the country border insurance.

After the occurrence of the damage event, the insured is obliged to notify the insurer in writing of the occurrence of the damage event within 15 days after its occurrence if the damage occurred in the territory of the Slovak Republic and within 30 days after its origin, as it originated outside the territory of the Slovak Republic.

Accident insurance is governed in the Slovak Republic by the Civil Code and insurance conditions. The Civil Code regulates insurance contracts, the process of insurance contract conclusion, termination of insurance, change of insurance, property insurance and limitation.

According to the provisions of Section 806 of the Civil Code of Property Insurance, the insured person has the right to receive a payment in the amount determined according to the insurance conditions if the insured event relates to a matter covered by the insurance.

The conditions of accident insurance of individual insurers are quite different. Most insurers have insurance options that offer different coverage options.

The subject of emergency insurance is the vehicle. The vehicle is most often defined as a self-propelled vehicle as well as other non-self-propelled vehicles for which a vehicle registration document is issued and which is subject to vehicle registration in the Slovak Republic. The trailer is a road vehicle designed to be connected to a motor vehicle. The vehicle at the time of insurance closure must be undamaged, in proper technical condition and fit for operation. Insurance is most often negotiated at a new value, i.e. the amount corresponding to the price of a new vehicle of the same type, quality, equipment without discounts at the time of purchase of a vehicle as new in the territory of the Slovak Republic. The territorial validity of insurance is the most common geographical area of Europe.

Insurance risks in accident insurance may be broken down by individual insurers' products. Insurers cover the most frequent risks of accident insurance: damaging or destroying the vehicle because of an accident, damage or destruction of the vehicle as a result of a natural occurrence, damage or destruction of the vehicle by vandalism, theft of part or all of the vehicle.

Assistance to accident insurance is multiple, collision avoidance with animals, windscreen attachment and others. Motor insurance assurance services are services provided by insurers as part of insurance free of charge. For a fee, the assistance services are usually with a larger range of assistance services, respectively higher coverage limits. Assistance services include a range of services that can be used by insurers within the limits and under certain conditions of the insurer: assistance services are covered by the vehicle during the period of compulsory insurance or accident insurance, the driver and the persons transported by the insured vehicle are entitled to the assistance services.

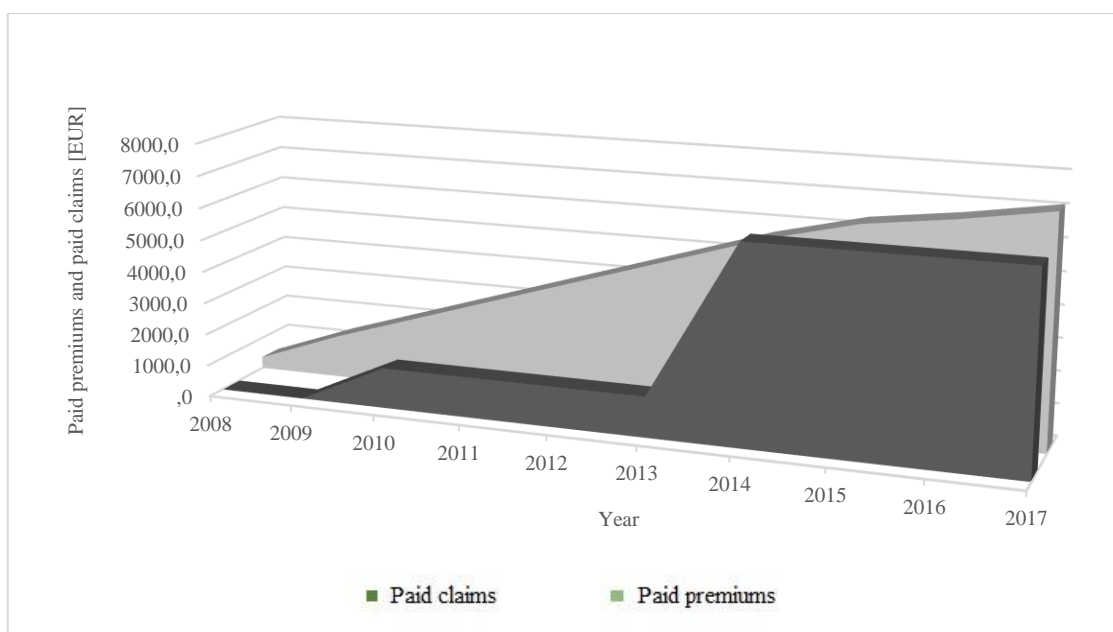
Motor insurance will be monitored between 2008 and 2017 in a real company operating in the Slovak Republic. State what motor vehicles the company used and what insurance it had for motor vehicles. The company, a small business, is listed in the financial and insurance activities sector. For our paper, we will call the company XY.

In 2008, the company acquired seven motor vehicles. All vehicles were Škoda, four Octavia and three Škoda Octavia Combi. One of the vehicles (Škoda Octavia) was stolen in 2009. In 2015, the company sold four motor vehicles (two Škoda Octavia and two Škoda Octavia Combi) and bought one Škoda Octavia. In 2016, the company bought two more Škoda Octavia vehicles. At present, the company owns four vehicles Škoda Octavia and one Škoda Octavia Combi. Compulsory insurance for liability for damage caused by motor vehicle company in 2008, negotiated in the Česká poistovňa - Slovensko, Inc. such as fleet insurance. The scope of compulsory contracted insurance arises from the law on compulsory contractual insurance. The obligatory contract insurance was provided by Česká poistovňa - Slovensko, a.s. assistance services. Assistance services were provided in the event of an unforeseen event because of a traffic accident or mechanical disruption in the countries listed in the Green Card.

From the information on the insurance of third party liability insurance company and information on claims paid by insurers show that in the reporting period was paid by insurance in the amount of € 7,134.11 and paid indemnity insurers in that period was € 6,156.78.

Figure 1 shows a graphical representation of the paid insurance by the company and claims paid by insurers for damaged from compulsory contractual insurance.

Figure 1 Comparison of Paid Premiums and Insurance Payments of Compulsory Contracted Insurance

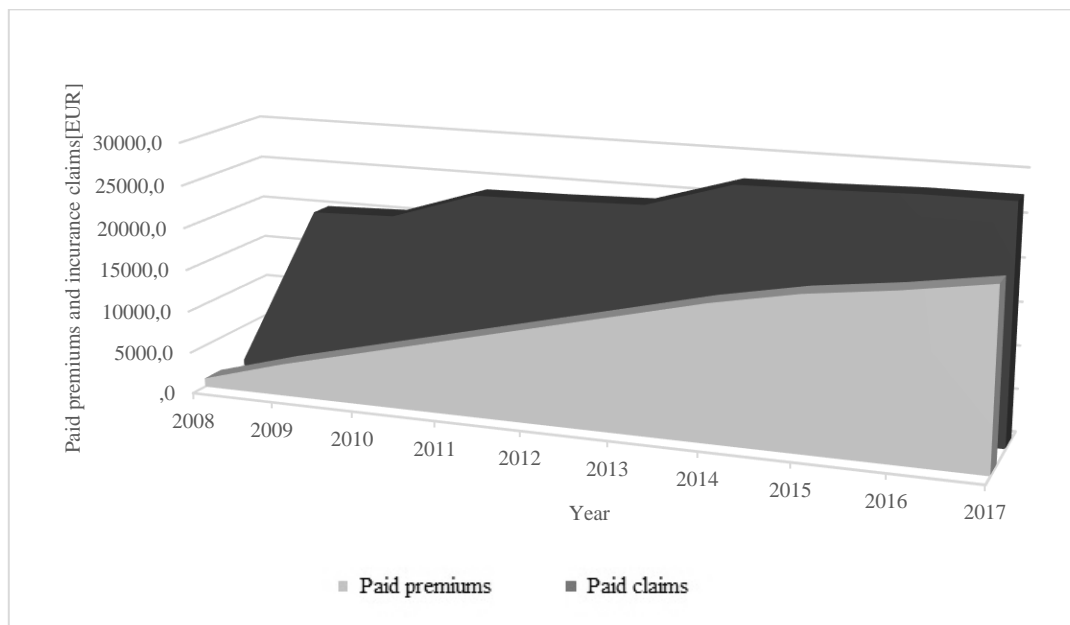


Source: Own processing based on internal company documents

In the monitored years, the company also paid premiums for accident insurance of € 20,869.13. In the case of insurers, 12 insurance events were claimed from the accident insurance, the amount of the indemnity amounting to € 27,600.65

Figure 2 shows a graphical representation of the paid insurance by the company and the insurance benefits paid by the insurers.

Figure 2 Comparison of Paid Premiums and Insurance Payments of Accident Insurance

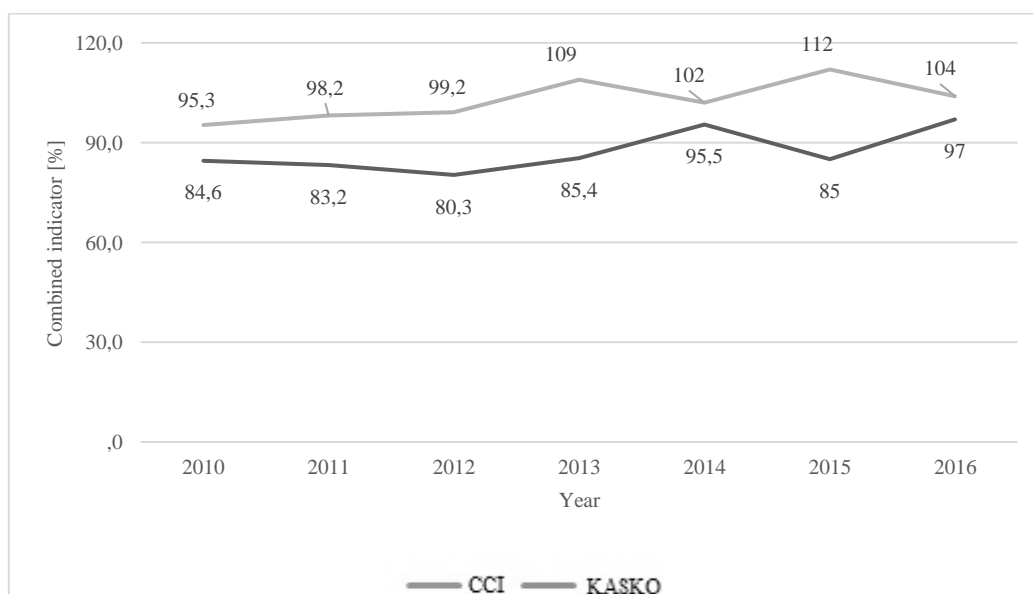


Source: Own processing based on internal company documents

The comparison shows that the company received € 27,600.65 on insurance claims from insurers. In total, the company paid premiums of € 20,869.13. Therefore, the company received 32% more than insurance premiums. The fact that the company had an accident insurance with economic benefits was due to the performance of a specific insurance event - theft of a motor vehicle in 2009.

Every year, the National Bank of Slovakia processes the analysis of the Slovak Financial Sector. In the section on insurance, it provides information on motor vehicle insurance. One of the main indicators of motor vehicle insurance is a combined indicator that expresses the loss and cost of insurance on the earned premium. Figure 3 shows a composite indicator for compulsory contracted insurance and accident insurance for the period 2010 to 2016.

Figure 3 Combined Indicator in CCI and KASKO Insurance



Source: Own processing based on internal company documents

In 2016, the combined indicator of motor vehicles continued to grow for a long time, and by September 2016, this sector was loss-making. The net combined motor insurance indicator was 101% (97% of the PZP, 104% of the accident insurance) as of September 2016. The premiums received did not cover the costs of claims. In the case of an estimate of gross combined indicator, this would be 100% in the case of accident insurance and 98% in the case of compulsory contracted insurance. As a result, motor insurance premiums do not cover insurance claims for long periods. The reasons why motor insurance is long-term loss are long-term problems in motor vehicle insurance.

Motor vehicle insurance in practice faces several problems with which insurers and insurances must deal with. There are some problems, insurers and insurers are bored for years such as insurance claims, total vehicle damage or non-material damage. With some of them, most of the insurers have already dealt with, for example, counting for wear and tear in real damage. Some of the problems are just overdue and insurers will have to deal with them soon, such as applying a more appropriate bonus / malus system.

4 Conclusions

The answer to the question of what development trends can be expected in motor insurance in the coming years is not easy at all, as it is not entirely clear how the insurance will change after legislative adjustments in the coming years. Some future things, such as, for example, tax deduction from motor vehicles, systematic driver education, and changes in age of driver adepts. The center of interest of the insurers, i.e. commercial insurers must be a client and an understanding of his ever-changing needs in these motor vehicle insurances. The introduction of new technologies will then enable personalized offers to be provided by commercial insurance companies that take even more into account the individual needs of clients and motorists.

Based on our data from selected private company, we can positively identify that the company received higher paid claims than the paid premiums in the analyzed period.

Expected trends in motor vehicle insurance will include the development of digitization and innovation, the expansion of insurance in compulsory contractual insurance and the convergence of compulsory contractual insurance and accident insurance. In the longer term, insurers will be faced with solving the issue of insurance vehicles.

Acknowledgments

The paper is the output of a scientific projects IGA no. 3/2017 „Development of international business and international management in the conditions of globalization”

References

Act no. 39/2015 Coll., on Insurance and on Amendments to Certain Acts.

Act no. 747/2004 Coll., on Oversight of the Financial Market.

Act no. 40/1964 Coll., Civil Code.

Čejková, V., Adamko, J., Kopanický, L. (2016). *Insurance, Theory and Practice*. Bratislava: VŠEMvs.

Čejková, V. et al. (2013). *Insurance market: Practicum*. 1st ed. Trenčín: Institute of Applied Management.

Čejková, V., Martinovičová, D., Nečas, S. (2011). *Insurance Market - Theory and Practice*. Bratislava: Iura Edition.

Čejková, V., Nečas, S. (2008). *Insurance market*. 1st ed. Bratislava: Merkury.

Grmanová, E., Čejková, V. (2016). *Insurance market in the Slovak Republic and the Czech Republic*. Trenčín: TnUAD.

Grmanová, E., Hošťák, P. (2016). Influence of selected environmental factors on the efficiency of commercial insurers. In: *Proceedings of the 13th International Scientific Conference European Financial Systems 2016*. Brno: Masaryk University, pp. 199-206.

Grmanová, E. (2015). Efficiency of National Life Insurance Markets in Europe. In: *Proceedings of the 12th International Scientific Conference European Financial Systems 2015*. Brno: Masaryk University, pp. 151-157.

Lisý, J. et al. (2016). *Economics*. 1st ed. Bratislava: Wolters Kluwer.

Paulík, D., Čejková, V. et al. (2012). *Fundamentals of Finance and Currency*. 1st ed. Trenčín: Institute of Applied Management.

Slovenská asociácia poisťovní. (2017). *Official web site*. Retrieved from: www.slaspo.sk.

XY's internal documents for 2008-2017.

Ratio Bias under Conditions of Uncertainty – Experimental Results

Maria Forlicz¹, Tomasz Rólczyński²

¹ Wrocław University of Economics
Faculty of Engineering and Economics, Department of Economic Sciences.
118-120 Komandorska Street, 53-345 Wrocław, Poland
E-mail: maria.forlicz@ue.wroc.pl

² WSB University in Wrocław
Faculty of Finance and Accounting, Department of Economics
29-31 Fabryczna Street, 53-609 Wrocław, Poland
E-mail: tomasz.rolczynski@wsb.wroclaw.pl

Abstract: *It has been found that when making decisions under risk regarding positive results (gains), people prefer lotteries with probabilities expressed as a ratio of large numbers (eg. the chance of winning is 30 to 1000) to lotteries with equal probabilities expressed as a ratio of small numbers (eg. 3 to 100)- it is a phenomenon called ratio bias (eg. Denes-Raj, Epstein [1994], Reyna, Brainerd [2008]). However, since it is usually impossible to know or to calculate probabilities of occurrence of various events, it seems plausible to claim that most decisions made in everyday life are decisions under uncertainty. That is why the aim of this article is to investigate people's perception of chances to win in a lottery under conditions of uncertainty when for the same price they obtain fewer or more tickets (with equal prices and number of tickets obtained for all participants). It is important to know if buying 1 ticket for 1 euro is as attractive as buying 10 tickets for the same price while the (unknown) probability of winning stays the same. The aim will be achieved by conducting an experiment with real but non-monetary pay-offs. Students will be given an opportunity to participate in a lottery in which one can win additional points to their final score in a subject. In Scenario I a student will be able to buy one lottery ticket for a small price, while in Scenario II 10 lottery tickets. In both scenarios the number of winning tickets will be the same. Along with ratio bias theory it is hypothesized that (with unchanged probability of winning) an increased number of tickets sold for a specified price will effect an increased demand for the tickets.*

Keywords: *decision under uncertainty, lottery, expected value*

JEL codes: *D120, D800*

1 Introduction

Every person makes hundreds of decisions every day. What to eat, when to get up from bed, what to wear, whether or not to buy a new car, to lend money to a friend. Scientists have shown that many of those decisions depend on the way the decision problem is described, which is a violation of the assumption of human rationality. Framing effect, well known in economic psychology, has been shown to influence people's decisions made under risk. For example Tversky and Kahnemann (1981) described a research in which the same decision-making situation was framed positively and negatively (concentrating on possible gains or losses), with the participants' decisions being significantly different. One of the manifestations of framing effect might be ratio bias effect which occurs when people judge the possibility of occurrence of some event as more probable when its probability is expressed in the form of an equivalent ratio of larger numbers than when it is expressed in smaller numbers. The aim of the paper is to check whether ratio bias appears also in decisions made under uncertainty. Definitions and difference between the notions of risk and uncertainty are a point of interest of many researchers and were described, for example, by Knight (1964), von Thünen (1910), Keynes (1921). Most commonly, it is assumed that the difference lies in knowing (in the former case) or not knowing (in the latter) probabilities of occurrence of some events or probability distribution. These differences can be shown by using the example of a lottery. Deciding whether to play in a

lottery in which the number of tickets and the number of winning tickets is known is to make decision under risk. If the number of tickets is not known or it is not known how many tickets are winning, we say we are in a situation of uncertainty. The hypothesis to be verified in the paper is that (with unchanged probability of winning) an increased number of tickets sold for a specified price will effect in increased demand for the tickets because the subjects of the experiment believe that obtaining more tickets will give them more chances to win. The hypothesis is to be verified on the basis of an experimental result.

2 Literature review

Along with Framing Theory, Support Theory proposed by Tversky and Koehler (1994) says that different descriptions of the same situation can lead to different values of subjective probability. People offered home insurance against all hazards are less likely to buy this policy than those who are offered insurance against fire, flooding, theft and other events. If an event is unpacked into smaller parts, it seems more probable. This situation may be caused by neglecting denominator and concentrating on the numerator, as in the case of a jointly packed description, the nominator is 1, and with an unpacked description the nominator increases to a number bigger than 1. In turn, denominator neglect might be a reason for ratio bias effect. One of the first studies that revealed the existence of this phenomenon was conducted by Miller et al. (1989). The authors asked participants what was more suspicious a) that a child would draw a chocolate cookie from a jar in which there were 19 oat cookies and one chocolate cookie, with the chocolate cookie being the child's favorite or b) that the child would draw a chocolate cookie from a jar in which there were 190 oat cookies and ten chocolate cookies. Participants on average judged a) as more improbable. Kirkpatrick and Epstein (1992) showed (based on experimental results with real but small payoffs) that people preferred drawing a ticket from a large pool when the probability of winning was small and from a smaller pool when the probability of winning was high, and reversely, they preferred drawing a ticket from a large pool when the probability of losing was high and from a smaller pool when the probability of losing was low. Denes-Raj and Epstein (1994) even showed that 82% of subjects made at least one non-optimal choice deciding to draw a ticket (actually a jelly bean) from a greater pool with a smaller percentage of winning tickets (actually red jelly beans) instead of drawing from a smaller pool but with a greater percentage of winning tickets. Slovic et al. (2000) demonstrated that 40% of clinical psychologists refused to discharge a mental patient from an acute civil mental health facility when risk of violence was stated as follows: "20 out of every 100 patients similar to Mr. Jones are estimated to commit an act of violence" and only 20% refused to discharge the patient when risk was given as "2 out of every 10 patients similar to Mr. Jones are estimated to commit an act of violence." Alonso and Fernandez-Berrocal asked participants a hypothetical question which job position they would choose to apply for themselves, and which job position they thought other people would choose to apply for if applying for one job gave 3 to 10 probability of obtaining the job, and in the latter case the probability was expressed as a 10 to 100 ratio. 68.6% would choose to apply for the first position but only 48.6% of participants believed that the others would make the same decision. 25.7% believed that from a logical perspective it was better to choose applying for the second job. Rudski and Volksdorf (2002) surprisingly found that the ratio bias was more prevalent for choices presented graphically than for those described textually. Amsel et al. asked participants which choice was rational: choosing a jar with 1 to 10 or 10 to 100 probability of winning, or being indifferent between drawing from the two jars. Only around 31% of subjects was moderately or strongly convinced that the only rational answer was being indifferent. However, Passerini et al. (2012) argue that ratio bias is only an experimental artefact and it decreases sharply when participants are given the option that allows them to express the correct answer (i.e. being indifferent between two equally probable options). In the present paper the authors describe an experiment in which subjects made a choice under condition of uncertainty and they were not given a choice between lotteries, with each participant choosing only how many lottery tickets to buy. Next, the demand for the tickets in two groups (which differed in the number of tickets obtained for a specific price) was compared. Separately, it was checked in a survey (with

different subjects) which lottery seemed more attractive and why. However, in the survey it was possible to say that the two lotteries were equally attractive.

2 Methodology and Data

In order to test the hypothesis stating that an increased number of lottery tickets sold for a specific price will increase the demand for lottery tickets, and to achieve the objective outlined in the introduction, an experiment was carried out. Further on in the paper, this study will be referred to as an experimental study. Subjects of the experiment were students of two universities, whose total number was 139 persons. The experiment involved offering students to participate in a lottery in which they could win additional points needed to obtain credit in a subject. The experiment was conducted according to two different scenarios:

Scenario I:

As part of a scientific experiment, I'd like to offer you participation in a lottery where the winning ticket is 21 points. Everyone of you can buy a chance of drawing **10 lottery tickets** in that you write down your first name and surname by hand on a sheet of paper a 100 times; if anyone feels like buying lottery tickets for a multiple of 100 complete signatures, in other words, for example, a chance to draw 20 lottery tickets from the box for 200 complete signatures, he or she is very welcome do so. In the box from which you will be drawing lottery tickets there will be 3 tickets which give you 21 points. The total number of tickets in the box depends on how many tickets the entire group will buy. Now please approach and tell me how many tickets you would like to buy. Please, make sure your declaration is well thought-out, because your withdrawing will have negative consequences in terms of points.

Scenario II:

As part of a scientific experiment, I'd like to offer you participation in a lottery where the winning ticket is 21 points. Everyone of you can buy a chance of drawing **1 lottery ticket** in that you write down your first name and surname by hand on a sheet of paper a 100 times; if anyone feels like buying lottery tickets for a multiple of a 100 complete signatures, in other words, for example, a chance to draw 2 lottery tickets from the box for 200 complete signatures, he or she is very welcome to do so. In the box from which you will be drawing lottery tickets there will be 3 tickets which give you 21 points. The total number of tickets in the box depends on how many tickets the entire group will buy. Now please approach and tell me how many tickets you would like to buy. Please, make sure your declaration is well thought-out, because your withdrawing will have negative consequences in terms of points.

Students were informed that in order to participate in the lottery one was required to refrain from any communication with other participants before making the decision about the number of lottery tickets one wanted to buy. The reason for this requirement was to make the conditions for decision-making uncertain, that is, when deciding to buy lottery tickets, participants would not know how many tickets had already been bought by other participants, and thus would not be able to calculate the probability of winning. Including in the scenario the clause about negative consequences, if one should fail to commit to "payment" for the ordered tickets, was meant to prompt students to make well-thought out decisions. Moreover, one should note that unlike other studies concerned with ratio bias, one did not manipulate here with the proportions of winning tickets in relation to a larger or smaller denominator (thus, the first group was not told that there were 3 winning lottery tickets to 100, and in the second group 30 to 1000); what was changed was the number of chances a given person could win, while the probability of winning was the same.

Furthermore, with a view to verifying the assessment as to which lottery seemed more favorable, an quasi-experiment was conducted in that participants were offered a hypothetical possibility of purchasing lottery tickets in one of the above mentioned lotteries (Scenario I or Scenario II), that is, purchasing 10 lottery tickets for a 100 signatures, or

purchasing 1 lottery ticket for 100 signatures (or multiples of 100). Students were supposed to indicate which lottery they would like to participate in and in addition, they were to provide a rationale for their choice. The objective was to collect information on the evaluation of attractiveness of those lotteries, and, first and foremost, the information on the motives which guided people in their evaluation of attractiveness. This study was conducted on 142 people, who were not the same as those who were subject to the experiment described earlier. This afforded the possibility to define which lottery participants would choose and which they would find more favorable.

3 Results and Discussion

139 people participated in the experiment. Table 1 presents the results of descriptive statistics for the experimental study conducted. With a view of consolidating and comparing the results as to the number of lottery tickets purchased, the number of the lottery tickets bought in the experiment, which was carried out according to Scenario I, was divided by 10. The results showed that the mean number of lottery tickets bought in the Scenario II experiment (1 ticket for 100 signatures) was bigger than the mean number of lottery tickets bought in the Scenario I experiment (10 tickets for 100 signatures). Those means were statistically significantly different at a significance level $\alpha=0.05$. Also, the median for Scenario II (3 lottery tickets) was bigger than for the Scenario I experiment (2 lottery tickets). The distributions were characterized by the same modes (1 lottery ticket) and right-hand side asymmetries.

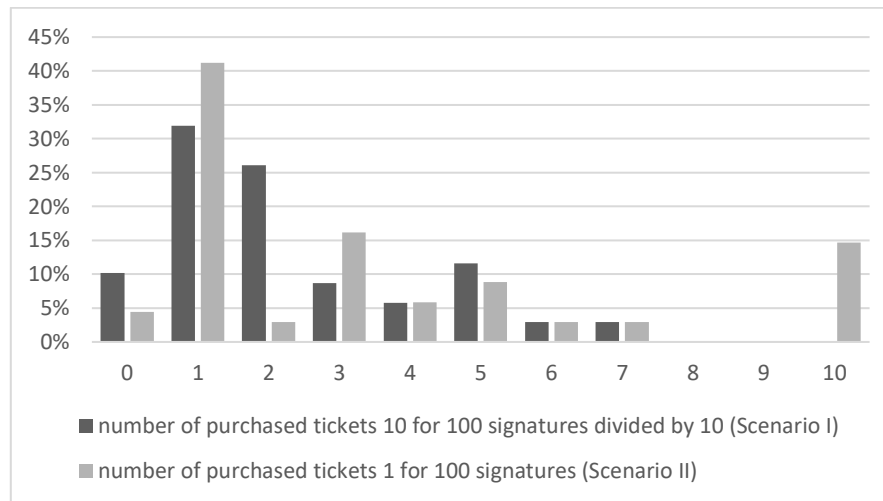
Table 1 Descriptive Statistics on the Number of Lottery Tickets Bought in the Case of Choice under Uncertainty

Variable	Descriptive statistics			
	Mean	Median	Mode	Sd
purchased tickets in the case of 10 tickets for 100 signatures (number of tickets divided by 10) – Scenario I	2.5429	2.0	1.0	2.7698
purchased tickets in the case of 1 ticket for 100 signatures – Scenario II	3.6522	3.0	1.0	3.4803

Source: Authors' own study

The distribution of the number of lottery tickets bought is presented in Figure 1. Extreme observations were disregarded in the distribution. Subjects were characterized by a smaller variation in terms of the number of tickets bought in the lottery conducted according to Scenario II, as compared to the Scenario I lottery. Surprisingly, there were fewer people who were not willing to buy any tickets at all in Scenario II (4% vs. 10% in Scenario I); and in Scenario II there was a substantial number of people who were willing to buy 10 tickets. Moreover, in Scenario I, buying two tickets was as nearly popular as buying one ticket.

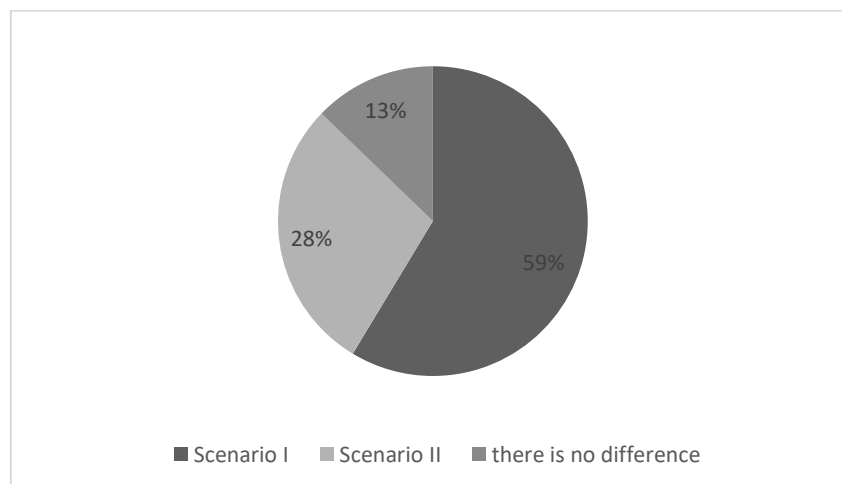
Figure 1 Distribution of the Number of Purchased Tickets in the Case of 1 for 100 Signatures and 10 for 100 Signatures



Source: Authors' own study

The second study intended to show which lottery respondents would choose if they had such choice. 52% of respondents would play the lottery according to Scenario I, while 41% would play the lottery following Scenario II. Moreover, considering the rationale for those choices it was determined which lottery respondents found more attractive on the whole. Attractiveness evaluation sometimes differs from the decision as to which lottery a particular respondent would participate in. The comment that was frequently stated was that "my friends will surely choose lottery X, so I choose...". This implies that in making their decision on lottery choice some respondents were prompted by predictions as to how other participants would behave and what would be their preferences, trying to increase in this way their own chances of winning. The results collected in the form of commentaries and rationale for respondents' choices allowed for assessing which lottery was perceived as more attractive. Even if the participant chose lottery designed according to Scenario II justifying his choice by saying that others would choose the Scenario I lottery, "because it is more attractive," that would indicate that in his view the lottery according to Scenario I was more attractive. The results of attractiveness evaluation are presented in Figure 2.

Figure 2 Percentage of respondents stating specified lottery was more favourable



Source: Authors' own study

Respondents decided that the more attractive lottery was the one designed according to Scenario I. 59% found the Scenario I lottery more attractive, while 28% found the lottery conducted according to Scenario II more attractive. 13% of respondents indicated that

they saw no difference in terms of the lottery attractiveness, stressing, in the justification of their choice, that the chances of winning were the same for both lotteries, since it did not matter whether one would buy one lottery ticket (or a multiple) for 100 signatures or 10 tickets (or a multiple) for 100 signatures. Still, out of the 13% there were some who chose to participate in either lottery, hence when it came to choosing the game, only 7% was reported to be indifferent as to the choice of the lottery. The analysis of the arguments justifying respondents' decisions allowed for explaining their behaviour. As a rationale for choosing a particular lottery, the majority of respondents wrote that they discerned a greater chance of winning when buying 10 lottery tickets for 100 signatures. Moreover, in the second form of arguments for a particular choice it was claimed that one needed to buy more lottery tickets in the lottery according to Scenario II so as to even up the winning chances, as compared to Scenario I. This kind of rationale explained why in the experiment there was a higher average demand for lottery tickets in the lottery conducted according to Scenario II. Respondents believed that buying tickets for lottery designed according to Scenario I provided a bigger chance of winning than in the Scenario II lottery. In order to increase their chance, they bought more lottery tickets in the experimental study in order to have a greater chance of winning. One can view this situation from the reverse perspective. If participants bought 10 lottery tickets for 100 signatures in the study according to Scenario I, then they saw their chance of winning as high enough so as not to feel induced to buy a bigger number of lottery tickets. Persons who found the Scenario II lottery more favourable argued that in this case the lottery pot would be smaller and thereby their chances of winning would increase. Persons who decided to participate in the Scenario II lottery noted that many people would not be willing to write 100 signatures just for one lottery ticket, and consequently they would buy fewer tickets, which in turn would increase the winning chances of persons filling up the questionnaire because they were less lazy than others.

4 Conclusions

Two studies were conducted in order to test the hypothesis stating that an increased number of tickets sold for a specific price would increase the demand for lottery tickets. The first study was experimental, while the second was quasi-experimental, since subjects were placed in the situation of a hypothetical choice. Additionally, in the quasi-experimental study, information was gathered on the motives behind the subjects' choices. On the basis of the collected information, one can assert that the lottery which people found more attractive was the one in which they could receive more lottery tickets for a specific price. In particular, in comparing the two lotteries, respondents explained their choices saying that they saw more chances of winning in the lottery designed according to Scenario I, compared to the Scenario II lottery. The hypothesis advanced was not confirmed. A greater number of lottery tickets to be bought for a specific price did not increase the demand for lottery tickets. On the contrary, it was the smaller number of lottery tickets for the same price that motivated participants to greater effort and to the purchase of more lottery tickets. The rationale for this situation came with the analysis of the answers provided by the participants of the quasi-experimental study who argued that given that the lottery conducted according to Scenario I gave a bigger chance of winning, there was no need to buy a multiple of 10 lottery tickets, which resulted in a decreased demand for lottery tickets in this lottery.

References

- Alonso, D., Fernández-Berrocal, P. (2003). Irrational decisions: Attending to numbers rather than ratios. *Personality and Individual Differences*, vol. 35(7), pp. 1537-1547.
- Amsel, E., Close, J., Sadler, E., Klaczynski, P. (2009). College Students' Awareness of Irrational Judgments on Gambling Tasks: A Dual-Process Account. *The Journal of psychology*, vol. 143, pp. 293-317.

- Denes-Raj, V., Epstein, S. (1994). Conflict between intuitive and rational processing: When people behave against their better judgment. *Journal of Personality and Social Psychology*, vol. 66, pp. 819–829.
- Keynes J. M. (1921). *A Treatise on Probability*. London: Macmillan and Co.
- Kirkpatrick, L.A., Epstein, S. (1992). Cognitive-Experiential Self-Theory and Subjective Probability: Further Evidence for Two Conceptual Systems. *Journal of Personality and Social Psychology*, vol. 63, pp. 534–544.
- Knight, F. H. (1964). *Risk, Uncertainty and Profit, Reprints of Economic Classics*. New York: Augustus M. Kelley.
- Miller, D. T., Turnbull, W., McFarland, C. (1989). When a coincidence is suspicious: The role of mental simulation. *Journal of Personality and Social Psychology*, vol. 57(4), pp. 581–589.
- Passerini, G., Macchi, L., Bagassi, M. (2012). A methodological approach to ratio bias. *Judgment and Decision Making*, vol. 7(5), pp. 602–617.
- Reyna, V. F., Brainerd, C. J. (2008). Numeracy, ratio bias, and denominator neglect in judgments of risk and probability. *Learning and Individual Differences*, vol. 18, pp. 89–107.
- Rudski, J., Volksdorf, J. (2002). Pictorial versus textual information and the ratio-bias effect. *Perceptual and motor skills*, vol. 95, pp. 547–54.
- Slovic, P., Monahan, J., MacGregor, D. G. (2000). Violence risk assessment and risk communication: the effects of using actual cases, providing instructions and employing probability versus frequency formats. *Law and Human Behavior*, vol. 24, pp. 271–296.
- Thünen, J.H. von (1910). *Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie*. Jena: Verlag von Gustav Fischer.
- Tversky, A., Kahneman, D. (1981). The Framing of decisions and the psychology of choice. *Science*, vol. 211 (4481), pp. 453–58.
- Tversky, A., Koehler, D. (1994). Support Theory: A non-extensional representation of subjective probability. *Psychological Review*, vol. 101, pp. 547–567.

Actuarial Model for Pricing Disability Insurance Policy

Ján Gogola, Lucie Kopecká

University of Pardubice
Faculty of Economics and Administration,
Institute of Mathematics and Quantitative Methods
Address: University of Pardubice
Faculty of Economics and Administration
Studentská 84, 532 10 Pardubice
E-mail: jan.gogola@upce.cz, lucie.kopecka@upce.cz

Abstract: *The main objective of our contribution is to apply stochastic processes for disability policy that gives annuity benefit in case of temporary or permanent disability. We apply durational effect to the disable state, by splitting it into several states. Using the data supplied by the Continuous Mortality Investigation (CMI) we calculate the single and annual premiums for that policy.*

Key words: disability insurance, Markov process, semi-Markov process, splitting of states,

JEL Classifications: C51, C52, G22, J11

1 Introduction

The main goal of this paper is to apply Markov process for disability income insurance benefits. The data we used in our contribution were supplied by the Continuous Mortality Investigation (CMI). The CMI is a research organisation established by UK actuarial profession.

Disability insurance, long-term care insurance and critical illness cover are becoming increasingly important in developed countries as it is mentioned in Pacáková, V., Jindrová, P. (2014). The private sector insurance industry is providing solutions to problems resulting from these pressures and other demands of better educated and more prosperous populations.

Most of the disability policies in UK are accelerated policies (88%) and they are attached to life insurance, term insurance or endowments. Typically, regular premiums are payable throughout the term while the policy is in force.

We describe the actuarial structure of disability insurance. Actuarial problems such as pricing and reserving are considered within the context of multiple state modelling, providing a strong and sound framework for analysing personal insurances.

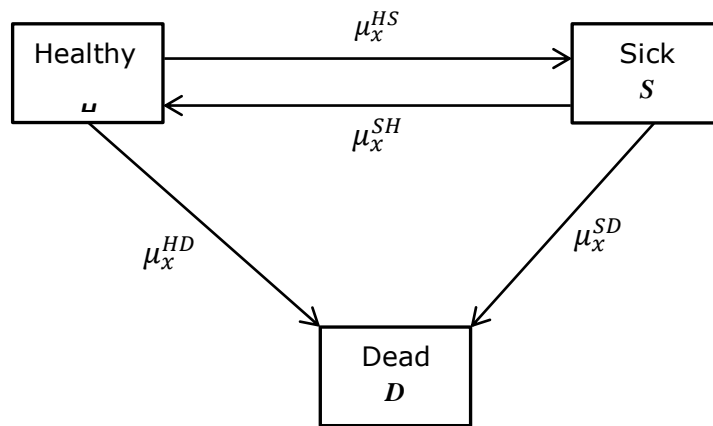
Our contribution is based on Markov process that can be used to develop a general, unified and rigorous approach for describing and analysing disability and related insurance benefits. The use of Markov process or Markov chain in life contingencies and their extensions has been proposed by several authors; for example Dickson, D. C., Hardy, M. R., & Waters, H. R. (2013), Haberman, S., & Pitacco, E. (1998).

2 Methodology and Data

Multiple state models are one of the most exciting developments in actuarial science nowadays. They are a natural tool for many important areas of practical interest to actuaries. They provide solid foundation for pricing and valuing complex insurance contracts. Many actuarial applications are modelled as time inhomogeneous Markov processes. Markov process assumes that probabilities of transitions at any time t depend only on the current state and not on the past. A Markov model for disability insurance has state space $\mathcal{S} = \{H, S, D\}$, where 'H' means healthy, 'S' sick (or ill) and 'D' dead. Transitions rates at each age x are illustrated in the Figure 1. An individual is, at any time t , in one of three states, "Healthy", "Sick" or "Dead". We can use this simple three state

model to define a random variable $Y(t)$ which takes one of the three values 'H', 'S' and 'D'. Suppose we have an individual aged x years at time $t=0$. The event $Y(t) = H$ means that an individual is healthy at age $x+t$, and $Y(t) = D$ means that an individual died before age $x+t$. The set of random variables $\{Y(t)\}_{t \geq 0}$ is an example of a continuous time stochastic process. We will assume that $\{Y(t)\}_{t \geq 0}$ is a Markov process. A policyholder is supposed to be healthy at the time of the commencement of the policy and he/she stays in this state until at some time he/she transits to one of the 2 possible states, that means a death or an illness occurred.

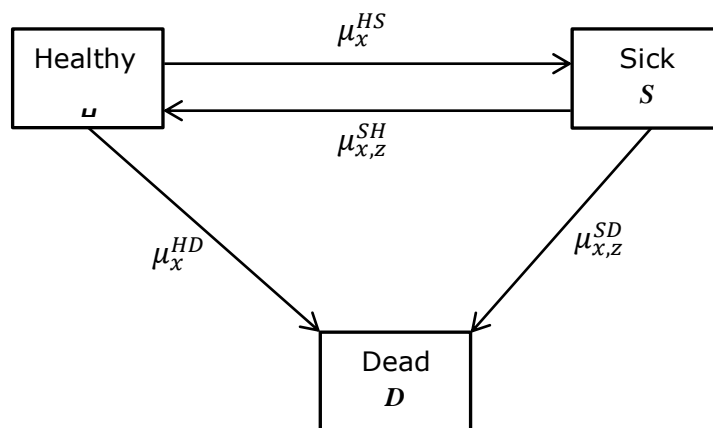
Figure 1 The Disability Income Model – Markov Model



Source: Own processing

It is perhaps more realistic to modify the previous model so as rates from "Sick" to "Healthy" and from "Sick" to "Dead" depend on the length of time z already spent in the "Sick" state, as well as on the age x of the individual. But then the Markovian property of the process is lost. This approach gives more complicated insurance policies which require more sophisticated model – semi-Markov model.

Figure 2 The Disability Income Model – Semi-Markov Model

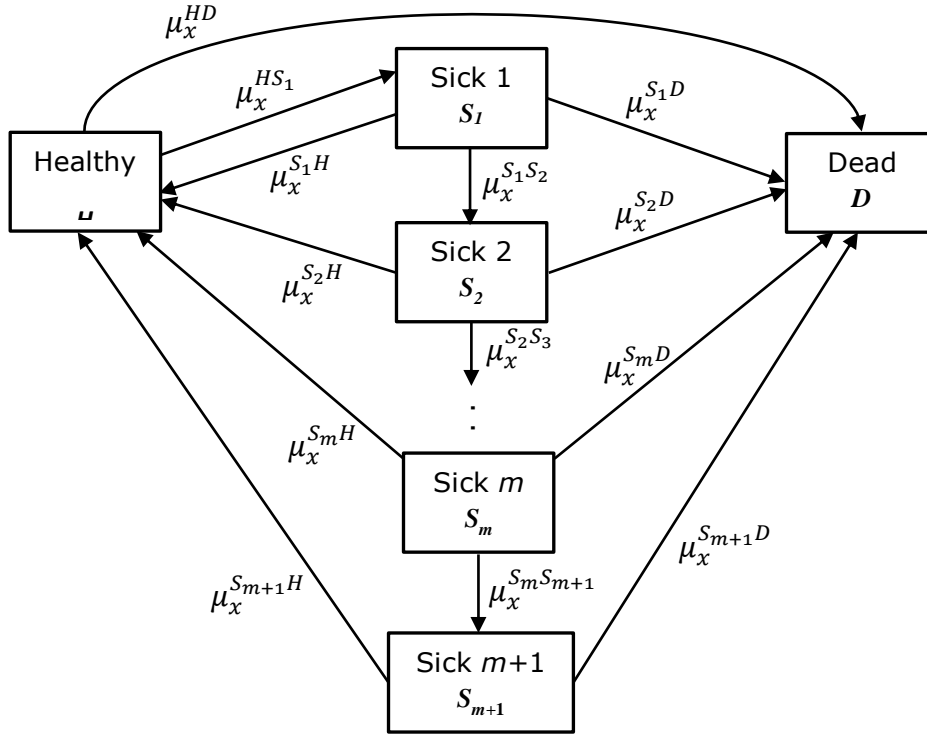


Source: Own processing

The disability income insurance pays a benefit during periods of sickness, the benefit ceases on recovery. Figure 2 shows a model suitable for policy which provides an annuity benefit while person is sick, with premiums payable while the person is healthy. The model represented by Figure 2 differs from that in Figure 1 in one important aspect: the

dependence of transition rates (and probabilities) on the time spent in the state "Sick" since the latest transition to that state.

Figure 3 Splitting of "Sick" State



Source: Own processing

We restrict the influence of the durational effect to some specified states. Let us replace state "Sick" by $m+1$ states $S_1, S_2, \dots, S_m, S_{m+1}$, where state

S_1 means that an insured is disabled with duration of disability between 0 and τ_1 units of time,

S_2 means that an insured is disabled with duration of disability between τ_1 and τ_2 units of time, ...

S_m means that an insured is disabled with duration of disability between τ_{m-1} and τ_m units of time,

S_{m+1} means that an insured is disabled with duration of disability longer than τ_m units of time.

Thus, we have made a splitting of state "Sick" of the state space $\mathcal{S} = \{H, S, D\}$. New state space is as follows: $\mathcal{S}^* = \{H, S_1, S_2, \dots, S_m, S_{m+1}, D\}$. Hence, we formally revert to the Markov process $\{X(t); t \geq 0\}$ based on the state space \mathcal{S}^* .

Thus, the introduction of more states representing the durational effect is a notational tool for treating semi-Markov model within the simpler Markov framework.

The splitting allows us to consider select intensities (and probabilities) without formally introducing a semi-Markov model (leading to major difficulties).

In general case, with states $H, S_1, S_2, \dots, S_m, S_{m+1}, D$ we refer to μ_x^{ij} as the force of transition or transition intensity between states i and j at age x . The transition intensities are fundamental quantities which determine everything we need to know about a multiple state model.

The model requires the following transition intensities:

$$\mu_x^{HD}, \mu_x^{HS_1}, \mu_x^{S_1H}, \mu_x^{S_1S_2}, \mu_x^{S_1D}, \mu_x^{S_2H}, \mu_x^{S_2S_3}, \mu_x^{S_2D}, \dots, \mu_x^{S_mH}, \mu_x^{S_mS_{m+1}}, \mu_x^{S_mD}, \mu_x^{S_{m+1}H}, \mu_x^{S_{m+1}D}.$$

As far as recovery is concerned, morbidity experience suggests:

$$\mu_x^{S_1H} > \mu_x^{S_2H} > \dots > \mu_x^{S_mH} > \mu_x^{S_{m+1}H}.$$

In particular it is possible put $\mu_x^{S_{m+1}H} = 0$, in the case of no recovery is possible after τ_m units of time.

Let us assume that a time-continuous Markov model has been assigned. Thus, the transition intensities have been specified and the transition probabilities have been derived. It is self-evident that the implied time discrete probabilistic structure can be immediately derived. To do this, we simply have to restrict our attention to transition probabilities ${}_t p_x^{ij}$ only, where x, t now denote integer values, so we get time-discrete Markov model.

Our splitting states model requires the following transition probabilities

$$p_x^{HD}, p_x^{HS_1}, p_x^{S_1H}, p_x^{S_1S_2}, p_x^{S_1D}, p_x^{S_2H}, p_x^{S_2S_3}, p_x^{S_2D}, \dots, p_x^{S_mH}, p_x^{S_mS_{m+1}}, p_x^{S_mD}, p_x^{S_{m+1}H}, p_x^{S_{m+1}D}.$$

3 Results

Consider the model (Figure 3) for a disability income insurance. The disability state is split into six states (due to available data). For states S_1, S_2, \dots, S_5 recovery is possible, whilst S_6 is assumed to represent permanent disability. These assumptions lead to the one-year transition matrix (or the transition matrix of one-year probabilities) of Table 1.

Table 1 One-year Transition Probabilities M_x

	H	S₁	S₂	S₃	S₄	S₅	S₆	D
H	p_x^{HH}	$p_x^{HS_1}$	0	0	0	0	0	p_x^{HD}
S₁	$p_x^{S_1H}$	0	$p_x^{S_1S_2}$	0	0	0	0	$p_x^{S_1D}$
S₂	$p_x^{S_2H}$	0	0	$p_x^{S_2S_3}$	0	0	0	$p_x^{S_2D}$
S₃	$p_x^{S_3H}$	0	0	0	$p_x^{S_3S_4}$	0	0	$p_x^{S_3D}$
S₄	$p_x^{S_4H}$	0	0	0	0	$p_x^{S_4S_5}$	0	$p_x^{S_4D}$
S₅	$p_x^{S_5H}$	0	0	0	0	0	$p_x^{S_5S_6}$	$p_x^{S_5D}$
S₆	0	0	0	0	0	0	$p_x^{S_6S_6}$	$p_x^{S_6D}$
D	0	0	0	0	0	0	0	1

Source: Own processing

For calculation we use transition intensities from the CMI Working paper 12. From these data we apply our model for the probabilities of disablement, i.e. $p_x^{HS_1}$,

$$p_x^{HS_1} = e^{-6,11+0,0458 \cdot x}, \quad (1)$$

and for the probabilities of recovery as a function of attained age x . For each state S_1, S_2, \dots, S_6 , the following functions are used

$$p_x^{S_jH} = \alpha_j - \beta_j \cdot x, \quad (2)$$

for $j = 1, 2, \dots, 6$.

The parameters α_j, β_j are given in Table 2.

Table 2 Parameters for Probabilities of Recovery

j	α_j	β_j
1	1,4161	0,0222
2	0,7400	0,0115
3	0,3739	0,0058
4	0,2855	0,0046
5	0,1918	0,0031

Source: CMI Report 12

We assume that the health mortality equals to general population mortality

$$p_x^{HD} = q_x = 1 - \exp\{-\int_0^1 \mu_{x+t} dt\} , \quad (3)$$

where μ_{x+t} is given by Gompertz-Makeham law of mortality $\mu_{x+t} = \mu_{x+t}^{HD} = a + b \cdot c^{x+t}$, with $a = 0.0005$, $b = 7,5858 \cdot 10^{-5}$ and $c = 1.09144$.

Probabilities of death for disabled insured, p_x^{SjD} (for $j = 1, 2, \dots, 6$), are assumed to be equal to $(1 + \eta) \cdot p_x^{HD}$, where η is the extra level of mortality of disabled. The technical rate of interest $i = 0.015$ p.a. (or 1.5 % p.a.) has been assumed.

Let $\ddot{a}_{x:n}$ denote the actuarial value of an annuity

$$\ddot{a}_{x:n} = \sum_{k=0}^{n-1} {}_k p_x^{HH} \cdot v^k , \quad (4)$$

where v is the discount factor ($v = \frac{1}{1+i}$).

The disability benefit (one monetary unit) is paid whatever disability state S_1, S_2, \dots, S_6 is occupied by insured.

Hence, the actuarial value of the disability benefit is defined, for a healthy individual, as follows

$$a_{x:n}^{HS} = \sum_{k=1}^n \sum_{j=1}^6 {}_k p_x^{HSj} \cdot v^k . \quad (5)$$

The disability annuity is assumed to be payable up to the end of the policy term n .

The actuarial value of the disability benefit is defined, for a disabled individual aged $x+t$ who occupies the state S_j ($j = 1, 2, \dots, 6$) as follows

$$a_{x+t:n-t+1}^{SjS} = \sum_{k=0}^{n-t} \sum_{h=1}^6 {}_k p_{x+t}^{SjSh} \cdot v^k ; \quad (t = 1, 2, \dots, n), \quad (6)$$

where ${}_0 p_{x+t}^{SjSh} = 1$ if $h = j$ and 0 otherwise.

The annual premium, $P_{x:n}$, payable for n years while the insured is healthy, is given by:

$$P_{x:n} = \frac{a_{x:n}^{HS}}{\ddot{a}_{x:n}}. \quad (7)$$

The calculation of the actuarial values defined by equations (4), (5) and (6) and then the calculation of premium according to formulae (7) imply the use of the underlying probabilities, which can be derived from one-year transition matrix M_x (Table 1). The product of one-year transition matrices at successive ages is a two-year transition matrix $M_x \cdot M_{x+1} = {}_2 M_x$. Continuing the matrix multiplication through subsequent ages, we can determine the k -year transition matrix ${}_k M_x$ for any integer k .

Table 3 presents numerical results for policy terms $n = 10, 15, 20$ years and $\eta = 0.20$ and illustrate single and annual premiums calculation in a time-discrete Markov context.

Table 3 Single and Annual Premium, $\eta = 0.20$.

Term\Age	$x = 30$	$x = 40$	$x = 50$
$n = 10$	0.18053	0.39654	0.81965
$n = 10$	0.01977	0.04469	0.09831
$n = 15$	0.36988	0.84171	1.72679
$n = 15$	0.02840	0.06785	0.15502
$n = 20$	0.66287	1.49959	2.88050
$n = 20$	0.04030	0.09819	0.22109

Source: Own processing

4 Conclusions

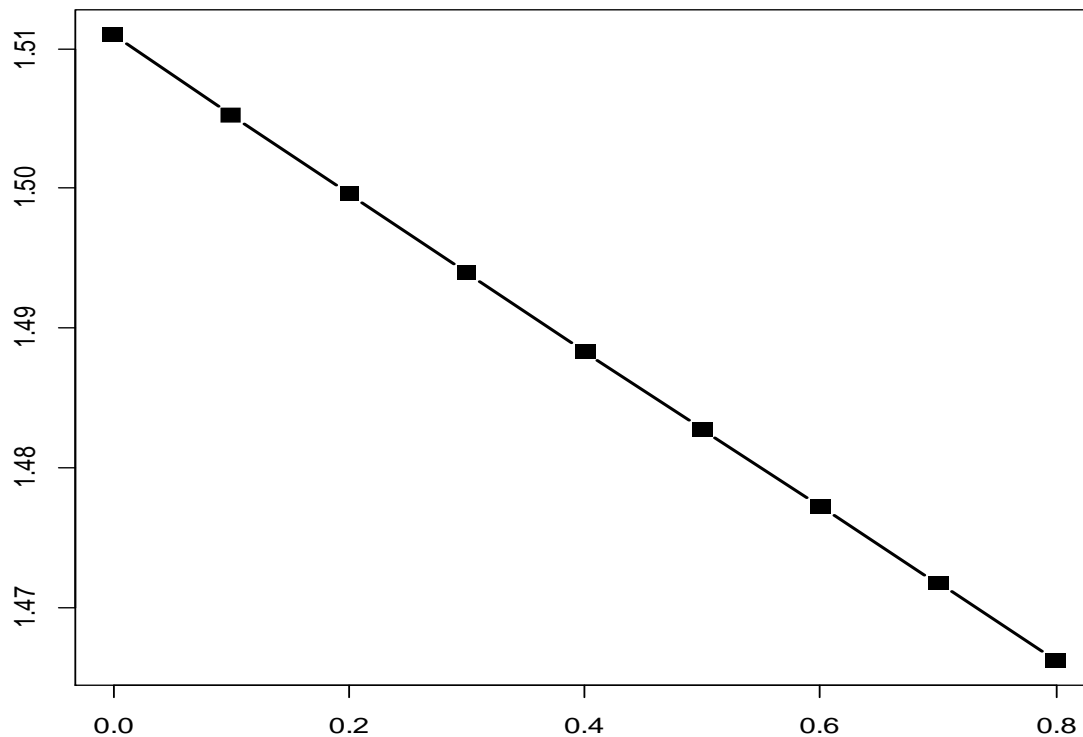
We have presented an application of multiple state models to problems in actuarial science. There are various extensions of multiple state models. One way is to allow the transition intensities out of a state to depend not only on individual's current age but also on how long they have been in current state. This breaks the Markov property assumption and leads to the new process known as a semi-Markov process. This could be appropriate for the disability income insurance process where the intensities of recovery and death from the sick state could be assumed to depend on how long the individual had been sick, as well as on current age.

We have to emphasize that no attempt has been made to discover a precise relationship between p_x^{HD} and p_x^{SjD} (for $j = 1, 2, \dots, 6$), i.e. probabilities of death for healthy and disabled insured. It does however suggest that an office which calculate disabled lives' reserves for claims in force, by assuming mortality according to a standard life table, may have an implicit margin of strength in its reserving basis. The Figure 4 illustrates the behaviour of single premium as a function of the extra level of mortality η .

The transition intensities are fundamental quantities which determine everything we need to know about a multiple state models. Therefore it would be useful to have data from domestic insurance industry. Our further research will focus on estimation of transition intensities for the Czech Republic (or other central European countries) in similar manner as in Pacáková, V., Jindrová, P., Seinerová, K. (2013).

There is a need for awareness of model risk when assessing a disability income insurance benefits and/or critical illness benefits, especially with long term. The fact that transition intensities can be estimated does not imply that they can sensibly describe future medical development.

Figure 4 Single Premium as a Function of the Extra Level of Mortality η ; $x=40$, $n=20$.



Source: Own processing

Acknowledgments

This research could be performed due to the support of the University of Pardubice student project grant no. SGS_2018_012, Využití rozsáhlých souborů dat pro management vybraných rizik ve veřejném a finančním sektoru. (Faculty of Economics and Administration).

References

- Continuous Mortality Investigation Report – CMIR12 (1991). The Analysis of Permanent Health Insurance Data. *Continuous Mortality Investigation Bureau*, The Institute of Actuaries and the Faculty of Actuaries.
- Dickson, D. C., Hardy, M. R., Waters, H. R. (2013). *Actuarial mathematics for life contingent risks*. Cambridge University Press.
- Gogola, J., Kopecká, L. (2017) Multiple state models for Critical illness policy, In: *Proceedings of the 14th International Scientific Conference European Financial Systems 2017*. Brno: Masaryk University, pp. 159-164. ISBN: 978-80-210-8609-8.
- Haberman, S., Pitacco, E. (1998). *Actuarial models for disability insurance*. London: CRC Press, Chapman & Hall.
- Pacáková, V., Jindrová, P. (2014). Quantification of Selected Factors of Longevity. In: *Proceedings of the 2014 International Conference on Mathematical Methods in Applied Sciences (MMAS'14)*. Saint Petersburg: Saint Petersburg State Polytechnic University, pp. 170-174.
- Pacáková, V., Jindrová, P., Seinerová, K. (2013). Mortality Models of Insured Population in the Slovak Republic. In: *Proceedings of the 7th Professor Aleksander Zelias International Conference on Modelling and Forecasting of Socio-Economic Phenomena*. Zakopané, pp. 99-106.

Effectiveness of Commercial Banks in Poland versus Bank Tax

Ewa Gubernat

Wroclaw University of Economics
Finance Department,
ul. Komandorska 118-120, 53-345 Wrocław,
email: ewa.gubernat@ue.wroc.pl

Abstract: *Effectiveness in the era of a market economy is one of the most important financial categories regarding the degree of achievement of the assumed priority. The same applies to banking operations, where efficiency management has already become a separate area of unit management. As part of the efficiency quantification process, there are used four groups of indicators: profitability, margins, workloads and employment efficiency. They are an important analytical instrument allowing to assess whether the bank's activity is conducted economically. The aim of the article is to assess the impact of a bank tax on the operational efficiency of commercial banks in Poland and the effects of its introduction on banking services for customer. The author draws attention to insufficient research on the consequences of tax and the stability of the banking system, in particular in the context of low interest rates and increased burdens borne by banks. The author accepted the hypothesis that the introduction of a new tax burden resulted in lowering basic ratios of banks' profitability and an increase in costs incurred by clients in connection with the use of banking products. The analysis of aggregated financial data was used to verify hypotheses.*

Keywords: bank tax, commercial banks, ROA, ROE

JEL codes: G21, H24, H71

1 Introduction

Efficiency in the era of a market economy is one of the most important financial categories. It mainly concerns the degree of achievement of the assumed goal. The same applies to banking operations, where efficiency management has already become a separate area of unit management. The banks' activities are additionally subject to taxes. The introduction of a bank tax prevents the instability of financial markets and limits the risk taken by banks.

In 2009-2012, the bank tax was introduced in 14 EU countries. This action was a reaction to the moral hazard of banks. The most important argument for the additional burden was the fact that private banks on the one hand led to the financial crisis and often benefited from the help of public funds. Therefore, they should bear financial responsibility (financial crisis liability fee). It was recognized then that it would limit the unstable sources of bank financing and would allow the governments of the EU countries to recover funds previously spent on rescuing the banking sector.

The Polish banking sector, which is the main source of financing the economy, is developing steadily. However, the adoption of a bank tax in Poland requires deeper reflection. Lack of evaluation of the potential effects of establishing this tribute can cause long-term negative consequences for the development of both the banking sector and the entire economy. It is extremely important that this type of tax does not generate a risk for financial stability and the dynamics of bank lending, which may ultimately harm the growth of the real economy. As a result, the conditions of loans or other services provided by banks could deteriorate and uncertainty could be created for these institutions.

The aim of the article is to assess the impact of a bank tax on the operational efficiency of commercial banks in Poland and the effects of its introduction on banking services for consumers. The author accepted the hypothesis that the introduction of a new tax burden resulted in lowering basic ratios of banks' profitability and an increase in costs incurred by clients in connection with the use of banking products. The analysis of aggregated financial data was used to verify hypotheses.

The introduction of a bank tax in Poland is unjustified due to the fact that these banks did not use state financial assistance, nor were they the cause of the financial crisis. Meanwhile, his goal was to increase the state budget revenues. In Poland, it was decided to accept additional banking tax in the form of tax. It was adopted by the law on tax from some financial institutions in early 2016. In contrast to regulations adopted in most EU countries, the Polish banking tax is purely fiscal. Bank tax in Poland differs significantly from regulations adopted in most EU countries. In EU countries, the basis for taxation of banks is usually their liabilities, these taxes are not strictly related to the scale of operations of banks, do not have a fiscal objective, and their amount is mainly due to the risk of operations. The project promoters justify its introduction with the necessity to increase the share of the financial sector in incurring tax burdens and its high profitability (Cichy and Puszer, 2016). The act stipulates that the bank tax is income of the state budget, whereas the subject of tax is the assets of entities that are its taxpayers. The Polish banking tax is not related to specific risks related to the financial system. Nor does it apply to public aid previously granted to the financial sector. Therefore, it may happen that its taxpayers will undertake actions (transactions) that do not affect the amount of their balance sheet total due to their desire to avoid paying this tribute. The least justified reason for the introduction of a bank tax is the fiscal objective, because the inevitable transfer of its costs to bank customers will mean an increase in the cost of loans, possibly a drop in interest rates on deposits or an increase in the prices of banking operations. The fiscal goal of a redistributive nature, although justified from the point of view of the state budget, is not justified in the case of caring for the safety and stability of the banking sector. The introduction of asset tax encourages financial institutions to optimize their balance sheets. Asset taxation may reduce lending in the long term, including a move away from long-term low-margin loans to more lucrative and short-term consumer loans and credits. Banks can theoretically increase the share of risky off-balance sheet transactions. The method of reducing the value of the tax base is, for example, the sale of portfolios of working and non-working loans. In addition, banks may provide them with guarantees or sureties to secure their bonds issued by these companies instead of financing their subsidiaries with loans.

Banks can theoretically increase the share of risky off-balance sheet transactions. The method of reducing the value of the tax base is, for example, the sale of portfolios of working and non-working loans. In addition, banks, in order to reduce the tax instead of financing their subsidiaries with loans, may give them guarantees or sureties constituting collateral for bonds. A bank contract is a construction classified in the so-called property taxes. Many indications have been formulated for the introduction of a bank tax and its introduction (Kil and Ślusarczyk, 2014):

The most important arguments are:.

- Greater financial stability
- Less financial speculation
- Lower costs of bank billing in the future due to limited use of public funds
- Possibility of allocating the collected funds from the tax for the restructuring of banks in a difficult financial situation
- In turn, the following arguments include, among others:
 - Increase in prices of products and banking services
 - Lack of equal treatment of all financial institutions
 - Lower ability of banks to accumulate capital
 - Reducing the efficiency of banks and, consequently, weakening their competitive position in the global financial market
 - Difficult separation of speculative and hedging transactions

The banking sector shows profits similar to other sectors of the economy, which is why the legitimacy of charging banks due to their allegedly extraordinary profit in relation to the non-financial sector is questioned.

2 Methodology and Data

The theoretical part of the work was based on a study of the subject literature, while the empirical part based on data obtained from the financial supervision committee. In order to determine the economic and financial standing of the banking sector, profitability ratios of total assets and return on equity ROE were used. As part of the efficiency quantification process, 4 groups of profitability ratios are applied (Capiga, 2003): margins, workloads and employment effectiveness. They are an important analytical instrument allowing to assess whether the bank's activity is economically effective.

Empirical studies covered the years 2015 - 2017 and they concerned the entire banking sector in Poland. The test results are presented in tabular and descriptive form. For the purpose of the article, three selected measures of profitability will be assessed: ROA, ROE and interest margin (NIM).

3 Results and Discussion

The decision to introduce a banking tax raised serious doubts. Among other things, they were concerned about unfavorable effects on lending, a reduction in the profitability level of assets and equity as well as a direct transfer of tax-related costs to banking services customers. The main source of financing for losses was to be increased fees and commissions from banking operations. In order to verify the veracity of the thesis, a comparison was made between the results from the basic banking activity before and after the introduction of the tax on some financial institutions. It can be noticed that in the analyzed period the margin increased. The total net interest income increased by PLN 4.6 billion, ie 12.0%. Reasons for this state of affairs should be sought on the side of stable lending and changes in the deposit and credit policy. Impulses stimulating lending development were low interest rates, improvement in the labor market and price stabilization in the real estate market. Recovery can also be observed for the portfolio of consumer loans and corporate loans. Lowering the interest rate on deposits, while increasing the price of some loans, allowed to raise the generated margins (Capiga 2003).

The persistent environment of record-low interest rates along with the improvement of investment and consumption moods allowed in the period from January 2016 to the end of 2017 to increase the balance sheet total by PLN 140 billion (5.8% year-on-year). On the assets side, the portfolio of debt assets and loans had the decisive share in the change, while on the liabilities side deposits of households and the public sector. At the same time, further strengthening of the capital base was noted. Own funds from the level of PLN 159.1 billion at the end of 2015 increased by PLN 39 billion at the end of 2017 (24.5% in the perspective of 2 years). The average total capital ratio at the end of the year reached 18.2%, which also meant an improvement compared to previous years - by 5.3 pp. in relation to 2015. A visible phenomenon on the Polish banking market was the improvement of operational efficiency through optimization of employment and sales network (2013-15,3 thousand of people to 2017-13.4 thousand people) (KNF, 2016).

Even before the introduction of the bank tax, mortgage margins increased. In 2015, several banks, despite strong competition in the market, decided to raise fees and commissions and reduce interest rates on deposits for retail clients and enterprises. Financial institutions also introduced fees for services that were not previously paid. However, the concerns about decreasing lending growth have not been confirmed. The increase in the sales of credit products was mainly driven by high internal demand and low interest rates.

In the short term (see table 1 and table 2), a drop in the interest rate on new deposits could be observed with an increasing interest rate on new loans. The increase in loan margins was temporary, which may indicate that the attempts made by banks to compensate for the tax burden on some financial institutions were limited by competitive pressure on the market. Thus, the assumption of the project was not confirmed that due to strong market competition, the tax will not affect the prices of banking services. Most of the costs of the bank tax were transferred to depositors, causing a quasi-reduction in interest rates on deposits.

Table 1 Selected Elements of the Banking Sector Income Statement

	Value (PLN mio)		Change	
	2016	2017	Mln PLN	%
Result of banking operations	59 315	61 763	2 448	4,1%
a) result of banking rest	38 024	42 629	4 604	12,%
b) result on fees and commissions	12 592	13 743	1 151	9,1%
c) other fees	8 699	5 391	-3 307	-38%

Source: Own study

Table 2 Selected Measures of Operational Efficiency

	Sector			Commercial banks			Cooperative banks		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
NIM	2,24	2,29	2,44	2,22	2,28	2,45	2,96	2,84	2,89
ROA	0,71	0,84	0,78	0,84	0,86	0,79	1,09	0,51	0,59
ROE	6,60	7,76	7,07	7,57	7,73	6,98	11,21	5,33	6,04

Source: Own study

For banks in Poland, the ROA calculated as the arithmetic mean increased from 0.71% to 0.78%. However, taking into account the results achieved in recent years, it should be noted that the value of the ratio is still low. Negative factors include the increase in operating expenses resulting mainly from new tax liabilities and an increase in the negative balance of impairment losses and provisions. However, it can be added that the average rate of return on assets of the Polish banking sector is still higher than the average rate in other EU countries.

The second analyzed profitability ratio is the ROE (rate of return). For the banking sector in Poland, ROE increased from 6.60% to 7.07%. Similarly, however, it is necessary to refer to previous years. Observation of data suggests that, in retrospect, current values are at a low level. High return on equity in previous years was the result of relatively low equity. At present, the rapid increase in the balance sheet total and the increase in equity as a result of the introduced prudential regulations do not allow maintaining the ROA at a higher level.

4 Conclusions

- The concept of introducing a bank tax prevents the instability of financial markets and limits the risk taken by banks.
- In the analyzed period 2016-2017, was observed an increase in lending dynamics. The increase in the sales of credit products was mainly driven by high internal demand and low interest rates. The increase was recorded for net interest income, which indicates an increase in the average interest margin. Using the environment of low interest rates, banks have reduced interest rates on deposits while at the same time increasing the interest rate on low loans.
- The Polish banking sector, which is the main source of financing the economy, has been developing steadily. The persistent environment of record-low interest rates, together with the improvement of investment and consumption moods, allowed, from 2016, an increase in the balance sheet total by approx. PLN 140 billion (5.8%).

- At the same time, further strengthening of the capital base was also registered. Own funds from the level of PLN 159.1 billion at the end of 2015 increased by PLN 198,1 billion at the end of 2017- 24,5%. The average total capital ratio at the end of the year reached 18.2%, which also meant an improvement compared to the previous year.
- Due to the short period of the banking tax in Poland, the risk associated with it has not yet been fully materialized. Therefore, it can not be ruled out that in the longer term the situation in the assessed areas will change, and banks will try to compensate for the costs of the bank tax through aggressive policy on margins and fees and commissions.

References

Capiga M. (2003). Ocena działalności placówki operacyjnej banku: dylematy metodologiczne i praktyczne. *Prace Naukowe Akademii Ekonomicznej w Katowicach*, p. 62.

Cichy A., Puszer B., (2016) Sektory bankowe w Unii Europejskiej. *Wydawnictwo Uniwersytetu Ekonomicznego w Katowicach*, p. 434.

Informacja o sytuacji banków w 2016 (2016). Urząd Komisji Nadzoru Finansowego, Warszawa 2016, pp. 17.

Kil K., Ślusarczyk R. (2014). Podatek bankowy w krajach Unii Europejskiej – ocena implementacji. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, vol. 348, p. 127.

Raport o stabilności systemu finansowego – grudzień 2016 (2016). Narodowy Bank Polski, Departament Stabilności Finansowej, Warszawa 2016, pp. 10.

Bitcoin Compared on Price, Liquidity and Volatility: Crypto “Currencies” or an Asset Class of Their Own?

Peter Haiss, Jakob Schmid-Schmidsfelden

WU University of Economics and Business
Department of Global Business and Trade, Institute of Export Management
Welthandelsplatz 1, Building D1, A-1020 Vienna, Austria
E-mail: peter.haiss@wu.ac.at; jakob.schmidsfelden@gmx.at

Abstract: *In comparing Bitcoin to other cryptocurrencies, we analyze whether these can become a viable alternative to fiat currencies. In the theoretical part we assess if these embody the main functions of a currency (Krugman, 1984). The empirical part analyzes the price development, liquidity and velocity of Bitcoin in comparison to the major other cryptocurrencies in 2017. We conclude that Bitcoin Cash, a cryptocurrency that evolved during a hard fork of Bitcoin, may develop into sharing features of a global currency. Currently cryptocurrencies are rather tokens and a highly volatile asset class of their own.*

Keywords: *blockchain; Bitcoin Cash; cryptocurrencies; liquidity; monetary velocity*

JEL Codes: *E390, E420, E510, G15, E51*

1 Introduction

In 2017, the cryptocurrency market experienced a development the economy had not yet seen before. Bitcoin and its competitors gained much attention in the financial sector of both positive and negative nature. The system of this cryptocurrency is based on a peer-to-peer network that allows transactions which are verified de-centralized by all the Bitcoin-users and then stored in the blockchain (Nakamoto, 2008; Haiss and Moser, 2017). It represents the idea of de-centralizing a currency. Therefore, it is formally independent from governmental authorities and financial institutions, though influenced by its activities (e.g. reacted to announcements by the Chinese government to forbid mining and trading in early 2018) (Allerstorfer, 2016). Cryptocurrencies not only could turn out to be a highly lucrative (though risky) investment opportunity, but also could represent a potential alternative (and thus a threat) to fiat currencies. Or is it just a token? A currency or rather an asset class of its own?

This paper is a comparative study based on descriptive data. The first part provides a theoretical background, discussing whether Bitcoin shares the functions of a currency as defined by Krugman (1984). The second part compares the development of the major cryptocurrencies Bitcoin, Bitcoin Cash, Ethereum, Litecoin and Ripple in 2017. We analyze their price development, liquidity and velocity. We conclude by discussing if these may represent a viable alternative to fiat currencies as a kind of a new asset class.

2 Cryptocurrencies and the Functions of a Currency

Features of Cryptocurrencies

Virtual currencies are digital on the one hand, and based on cryptography to secure the system on the other hand (Lee, 2016). Cryptocurrencies are tokens that use “cryptographic hashing and digital signatures to verify transactions and avoid double spending” (Halaburda & Sarvary, 2016). Cryptography is used to prevent unauthorized access of particular content (confidentiality) and unauthorized changes (integrity). It enables involved parties to identify each other as well as the information sent (Allerstorfer, 2016).

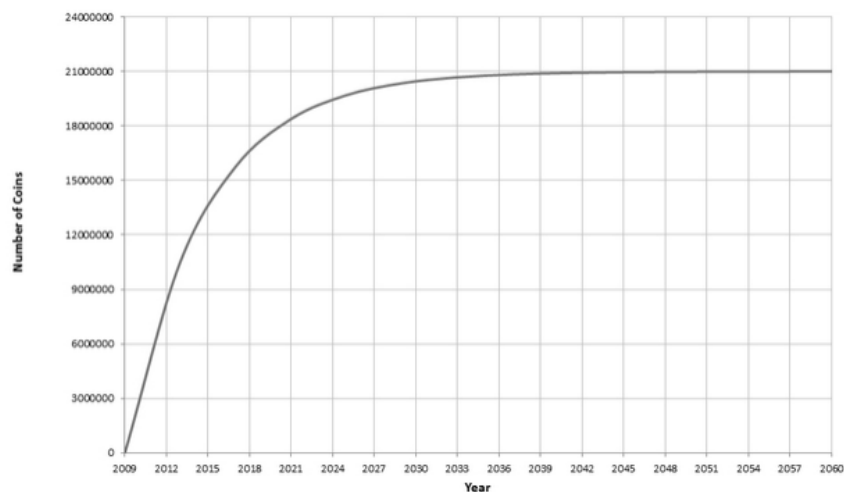
When Bitcoin was introduced in 2008, it was the first of all cryptocurrencies. At the time of writing (Q2/2018), there are about 1.500 different cryptocurrencies existing, which have all emerged after the introduction of Bitcoin (see Coinmarketkap.com for the current status). In essence, Bitcoin features as a decentralized peer-to-peer digital “currency” based on cryptography, with a more or less finite monetary supply (Nakamoto, 2008). Every direct transaction made is verified de-centrally by a network of Bitcoin users. This

means that it is possible to carry out transactions “without the assistance and verification of a trusted third party” (Lee L. , 2016). As most other cryptocurrencies are based on some type of blockchain all of their functions including storing, transferring, buying and selling are executed completely online (Osterrieder, Chan, Chu, & Nadarjah, 2017).

As cryptocurrencies are a relatively new phenomenon, a precise legal definition of virtual currencies does not yet exist, though several countries enacted special cryptocurrency laws, e.g. the 4th Anti-Money Laundering Directive by the EU, which only includes exchanges between cryptocurrencies and fiat currencies, or the US virtual currency law (EDCAB, n.d.; Waters, 2017). According to Tymoigne & Wray (2005), it is crucial for any monetary system to be based on a structure that is capable of recording transactions. In the case of cryptocurrencies this necessity is fulfilled through the blockchain.

The blockchain, which is often seen as the key innovation of Bitcoin, is a distributed ledger system that stores and keeps record of all Bitcoin transactions (Haiss & Moser, 2017). This ledger is increased as miners add new blocks to the chain in a chronological order, whereas hundreds of transactions are stored and verified in every individual block. The blockchain is called a public ledger, because every transaction can be associated with a particular Bitcoin address (information publicly available by using a block explorer, e.g.: <https://blockchain.info/>). In order for a block to be added to the ledger, a miner first has to discover it, before all miners can verify it. This is achieved by solving a cryptographic mathematical problem through computational effort. That process is called proof-of-work (Dwyer, 2014). The first miner that verifies the blockchain receives a reward in the form of newly created Bitcoins and a transaction fee. Besides mining, another option to acquire Bitcoins is to exchange it for fiat money, by buying it either from people through Bitcoin wallets or from an exchange platform (Swan, 2015). A major disadvantage of the proof-of-work system is that this process makes mining and payment transactions extremely energy extensive and thus very costly (Harm, Obregon, & Stubbendick, 2016).

Figure 1 Bitcoin (BTC) Supply over Time



Source: Antonopoulos, 2017

The supply of Bitcoin, which is governed by an algorithm, is limited to 21 million Bitcoins. The algorithm of the issuance schedule adjusts itself by halving the amount of the possible creation of new Bitcoins every four years (Antonopoulos, 2015). This adaptation is achieved by increasing the difficulty of the algorithm that needs to be solved by the miners (Dwyer, 2014). It is important to note, that the number of blocks discovered per year does not change (52.500), and only the amount of Bitcoins per block is halved every four years (every 210.000 blocks). The idea behind this decreasing-supply algorithm is to best imitate a rare commodity like gold. Cermak (2017) estimates that “99% of all Bitcoins will be “mined” by 2040 and the remaining 1% will be mined over the next 80-100 years”. The decreasing issuance model also contributes to an increased amount of energy (i.e. rising cost), leading to a decreasing rate at which Bitcoins are mined (Antonopoulos, 2017; see

figure 1). As the rate of newly created Bitcoins is decreasing, the value of each Bitcoin is likely to rise. This is also one of the main reasons why investors are likely to hold Bitcoin as a speculative investment. Furthermore, the decreasing issuance schedule suggests an increase of the transaction fees, since the reward the miners receive, denominated in newly created Bitcoins, will get smaller.

According to Krugman (1984), in the classical economist definition, money serves three functions: it is a medium of exchange, a unit of account, and a store of value for both the private and official sector. As virtual currencies so far mainly operate in the private sector (Bech & Garratt, 2017), we will focus on that.

2.2 Features of Traditional (fiat) Currencies

According to Cermak (2017), "For a currency to function as a medium of exchange, it must represent a standard of value accepted by all parties. The most essential function of a medium of exchange is to measure value. A medium of exchange should have a constant intrinsic value and a stable purchasing power on average."

Table 1 Functions of a Currency

	Private	Official
Medium of exchange	Vehicle	intervention
Unit of account	Invoice	peg
Store of value	Banking	reserve

Source: Krugman, 1984

The second dimension of money mentioned by Krugman (1984) is the function as a *unit of account*. The main aspect of a unit of account is its ability to serve as a standard numerical unit and measure the value and costs of goods, services, assets and liabilities (European Central Bank, 2012). No monetary system could perform accordingly without an asset that functions as a unit of account, as this function is also needed to ensure an accurate method of recording transactions. Traditionally, the unit of account function was always associated to some kind of a central authority that set standards (Tymoigne & Wray, 2005). Yet, this perception will most probably have to change in future times, because of the introduction and emergence of the blockchain.

The third major feature of a currency is its function as *store of value*, ie to preserve value over time (Lehdonvirta, 2014). Clearly, this implies the need for a stable respectively somewhat predictable price development. Enough liquidity is another basic function for the store of value dimension, as the value of something that cannot be exchanged for other goods and services at any point in time is useless to function as money (Cermak, 2017). A further key characteristic concerning the store of value is the predictability of supply. Knowing by what degree the supply will increase or decrease can give a suggestion of how much inflation or deflation should be expected in the future. By being aware of the future supply, one can be confident not to experience a sudden drop in purchasing power of used the currency (Ammous, 2016). One very important aspect why gold is one of the most reliable mediums of exchange, is its ability to store value over time. This is due to its property for being extremely durable and hard to counterfeit. Furthermore, its supply is limited and difficult to harvest, which makes it a rare resource (Ammous, 2016).

Throughout the modern history of money, there has always been some kind of central authority in charge of the monetary system (Cermak, 2017). Accepting a third party to be in charge of the monetary base has many advantages, but also demands some degree of trust by the general public in central banks. On the positive side, institutions in charge of the monetary system will not only aim to act as a guardian of price stability, but also stand ready to lend money to financial institutions in times of financial crisis or deflationary collapse and engage in various open market operations (Ammous, 2016). On the contrary, a third authority has the power to influence and manipulate the workings and ground rules of currencies. Within the boundaries of their bylaws, central banks can basically create as

much money as they want (Malliaris, 2005). In some cases, this led to extreme cases of inflation. Illustrative examples in this context would be the hyperinflation in Venezuela or also Russia at the demise of the Soviet Union.

Krugman's typology (1984) connects "trust" with the currency itself instead of connecting it with the authorities in charge. As part of the store of value function of a currency, Krugman simply argues that trust comes with stability. Thus, if a currency is not stable enough due to high inflation or political uncertainties it will probably also be used less, because the general public would not trust the currency. The ECB (2012) specifies the importance of trust in the current monetary system:

"Fiat money is any legal tender designated and issued by a central authority. People are willing to accept it in exchange for goods and services simply because they trust this central authority. Trust is therefore a crucial element of any fiat money system."

With the emergence of the blockchain and cryptocurrencies, a new way of regulating monetary systems evolved. The blockchain system allows parties to transfer funds directly to one another, using a peer-to-peer system (Lee, 2016). This weakens respectively removes the need for a trusted third party. In such a decentralized monetary system, it is possible to fully rely on a system to record transactions without the need of an intermediary in control (Nakamoto, 2008). This game-changing fact redefines the definition of trust in a currency. In contrast to fiat currencies, trust in the world of cryptocurrencies is based on cryptographic proof and technology instead of intrinsic value or a third authority (Fink & Johann, 2014). By introducing the blockchain, Nakamoto not only removed the need for a trusted third party, but also figured out a way to avoid double spending. This is possible because the blockchain records every transaction on a "public time-stamped ledger" (Cermak, 2017). Cryptocurrencies are also not obliged to a certain location or jurisdiction.

3 Price development, Liquidity and Velocity of Major Crypto-"Currencies"

Cryptocurrencies Chosen

In the following, we compare the five strongest cryptocurrencies, namely Bitcoin, Bitcoin Cash, Ethereum, Litecoin and Ripple. The reason for choosing these cryptocurrencies was mainly their market capitalization, but also because they show distinct approaches in offering digital currencies. Table 2 provides an overview of their major features.

These are, however, not without alterations. For example, the community could not agree about increasing the blocksize of Bitcoin (from initially 1 MB), although trying for years. To raise blocksize to 8 MB, *Bitcoin Cash* was launched in a "hard fork" from Bitcoin as a new cryptocurrency in August 2017. Every Bitcoin holder as of block number 478.558 received equally as many Bitcoin Cash as they had Bitcoin at this exact time. Thus there are two separate Bitcoin blockchains that coexist without interfering with one another. Bitcoin Cash is exactly the same as Bitcoin, just with the advantage of lower transaction costs and faster verification times (due to its scalability; BitcoinCash.org, 2017), making it a better substitute for fiat currencies.

Ethereum is a platform that allows different kinds of distributed applications in the form of peer-to-peer "smart" contracts to function without fraud or trusted authority interference (Ethereum.org, 2017). The fundamental technical differences to Bitcoin lie in the programming language and the required time to verify transactions (Bajpai, 2017). Ethereum could process an infinite amount of transactions, since it is not limited in its blocksize as is the case for Bitcoin. There is no maximum amount of Ether, but the amount issued per year is capped to 18 million Ether (Harm, Obregon, & Stubbendick, 2016).

Litecoin was designed by modifying the Bitcoin software. Just like Bitcoin, Litecoin is based on a peer-to-peer system and uses open-source software (Jakes, 2016). The reason for launching this virtual currency was to decrease the block generation time to 2.5 minutes to make it better suited for smaller transactions and to provide better cybersecurity.

Ripple has a very different approach compared to the other virtual currencies, as it is designed to only facilitate trade relationships to send money on a global basis. Therefore,

it does not embody a substitute to the current financial system per se. The idea behind Ripple is that every currency should only be exchangeable by going through Ripple itself, instead of being able to exchange every currency with any other currency. However, similarly to Bitcoin, Ripple also has a limited supply. It is a peer-to-peer system and intends to allow financial transactions without the need of a third-party authority (Jakes, 2016).

Table 2 Comparison of Cryptocurrencies

Name (Founder)	Re- lease	Sym- bol	Market Capitali- zation USD bn	Price (USD)	Hash algo- rithm	PoW/ PoS	Comment
Bitcoin BTC (Satoshi Nakamoto)	2009	BTC, XBT	145,7	8.650,51	SHA- 256d	PoW	1 st based on block- chain
Bitcoin Cash	2017	BCH	19,7	1.160,96	SHA- 256d	PoW	Hard fork from BTC (increased blocksize)
Ethereum (Vitalik Beterin)	2015	ETH	87,8	901,28	Ethash	PoW/ PoS	Platform for smart contracts
Litecoin (C. Lee)	2011	LTC	7,1	128,19	Scrypt	PoW	similar to BTC
Ripple (Larsen & McCaleb)	2013	XRP	33,2	0,85078	ECDSA	Con- sensus	For peer- to-peer trans- actions

Source: Adapted by the authors from Wikipedia (2018) and Coinmarket.com (2018)

Measures Chosen

The first selected measure is price development. A stable price is the strongest indicator for the stability of a currency, high volatility shows incompatibility for the medium of exchange function. A currency that is very volatile in its price is very unlikely to be used as store of value as it embodies great uncertainty about its future value. An unstable currency is unsuited to function as a unit of account. For our analysis, we checked price development in USD, as this is the most used currency to trade cryptocurrencies.

The second selected measure is the liquidity of each currency. Liquidity is a precondition for any currency to function as medium of exchange. If there is no counterparty willing to accept an asset, it cannot be exchanged immediately at a certain market (Damodaran, 2013), which would make it unsuitable to function as a medium of exchange, as it cannot guarantee trade at any time at a fair price anymore. In order to measure illiquidity, either the transaction costs or the time that is needed to execute a transaction can be taken as a measure (Damodaran, 2013). Additionally, liquidity is also essential to fulfil the function as a store of value. If an asset has a very low trade volume (which is a typical measure for liquidity), it cannot be sold easily on the market (Chordia, Roll, & Subrahmanyam, 1999). This makes it less favourable to be used as a store of value. Furthermore, the trade volume is a convenient measure for the breadth of a market, which gives insights in both the amount and size of transactions as well as the influence of transaction costs (Lybek & Sarr, 2002). For our analysis, we use the daily 24h trade volume as a measure, compiled from Coinmarketcap.com. We also looked at transaction costs.

The third measure we apply is the velocity (of circulation). According to Amadeo (2017), "The velocity of money is the rate at which people spend cash. It is how often each unit of currency, such as the U.S. dollar or euro, is used to buy goods or services during a period." This definition implies that the lower the velocity the higher the tendency that the currency is used as an investment, rather than as a medium of exchange. People will not want to

pay with a “currency” which could exponentially rise in a very short period and rather hold on to it. High velocity, on the other hand, implies that individual units of a currency change hands on a very frequent basis (Amadeo, 2017). Therefore, the function as a medium of exchange is the one function most affected by this measure. For our analysis of the velocity of circulation, only data for Bitcoin was available, compiled from blockchain.info.

Descriptive Comparison

As observation period, we chose November 2015 to November 2017. This covers the period in which the breadth and depth of cryptocurrencies developed strongly, but excludes the “fat tails” in its beginning and the outliers from the extreme hype around the change of the year 2017/2018. We also tie in findings from related research.

Concerning the price development of the selected cryptocurrencies, each of them shows both a significant increase in value, but also a very high degree of volatility, especially in 2017. If you had invested \$5 on November 12, 2015, in Bitcoin, you would have got roughly \$100 in late 2017, which is more than twenty times as high. After a slow but constant increase in price in 2016, in April 2017 Bitcoin sharply surged, due to the fact that Japan announced Bitcoin as legal tender. This indicates that Bitcoin is not entirely independent from governmental actions, which is not in line with the claims made by its supporters. Bitcoin continued its race to almost \$3.000, until the price started to fall again in June 2017, when it decreased about 40% in only one month. This freefall was mostly triggered by uncertainties among Bitcoin holders about the upcoming programme code upgrade, which was set for 1st of August 2017 (Rizzo, 2017). Nevertheless, from mid-July 2017 onwards, Bitcoin set for another extreme rise in price, hitting a record high of \$4.800 in early September. This development was strongly supported by the hard fork on 1st of August and the activation of Segregated Witness in late August, which drew a lot of media attention towards Bitcoin (BitcoinCash.org, 2017). In early September, China announced that it will ban ICO’s (Initial Coin Offerings), which might have been the cause for the next downswing (Merkel, 2017). When J.P. Morgan publicly called Bitcoin a “fraud that will ultimately blow up”, Bitcoin continued its downward race (Monaghan, 2017). After hitting a price slightly below \$3.000 in mid-September, Bitcoin set off for another very fast price hike. Once the CME Group, one of the biggest options and futures exchanges worldwide, announced that it would offer Bitcoin Futures, the price of Bitcoin soared to a new record high of over \$6.500 in late October (Baker & Leising, 2017). Bitcoin maintained its upswing as the 16th of November approached, which was set to be the day for the introduction of Segwit2x (Russo, 2017). However, shortly before this day arrived, the split was cancelled, which caused the Bitcoin price to plunge from its all-time high of \$7.400 down to \$6.625 on 12th of November 2017.

Similar to Bitcoin, the time between 2015 and 2017 was by far the strongest period for Ethereum. In only two years its price increased by more than 3.000%, from less than \$1 to over \$300. On November 12, 2017 Ethereum had a price of roughly \$308. Until March 2017, the price of Ethereum almost increased twentyfold to reach a price of almost \$20. From there on, it started a strong upward phase, before reaching its all-time high of \$390 in mid-June 2017. This remarkable increase in price most probably occurred, because of a rise in adoption of the whole cryptocurrency industry and an overall ICO hype in 2017 (Aru, 2017). Nevertheless, Ethereum saw itself on a downward race for a whole month until mid-July when it hit a price of \$150, which represented a price reduction of 60%. This extreme fall represented a market correction and was also triggered by wrongly distributed news about the death of Vitalik Buterin, the founder of Ethereum (Reiff, 2017). From there on, Ethereum benefited from the increased media coverage of Bitcoin, which resulted in a rise of Ethereum’s price. Ethereum regained almost all of its value of mid-June to reach around \$380 on 1st of September 2017. Ethereum was then heavily affected by the announcement of China to ban ICO’s, as ICO’s most often run through Bitcoin and Ether (Merkel, 2017). From there on Ethereum continued a very volatile development in October and early November 2017, before it hit \$308 on November 12th.

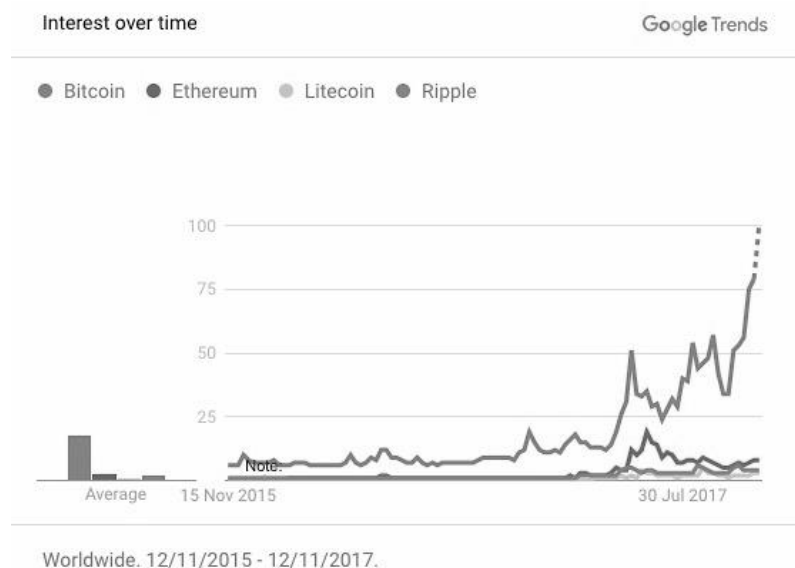
Compared to Ethereum and Bitcoin, Litecoin only increased marginally between November 12, 2015 and April 2017, trading at a stable price between \$3 and \$4. It was in mid-April

2017, when Litecoin also profited from the general rise in acceptance of cryptocurrencies by the general public. This upward trend was further supported by the successful activation of Segregated Witness in early May (Hertig, 2017). From there on, Litecoin continued its surge until it reached an all-time high of over \$82 on 1st of September at the time. Litecoin was also heavily affected by Chinas announcement to ban ICO's in early to September, which led to a drop to \$42 within just one week (Merkel, 2017). I recovered to trade around a price of \$60 as of November 12, 2017.

As of November 12, 2017, Ripple's is \$0.196. It experienced its all-time high in mid-May with a price of \$0.41. This price peak could only be maintained for a very short period of time. In general, Ripple followed the overall trend of the cryptocurrency market by significantly increasing its value from May 2017 onwards. Up to the time of writing, there is very limited literature on reasons for price changes of Ripple. However, in general it can be assumed that the price of Ripple is strongly influenced by news about the acceptance of cryptocurrency by retail banks and central banks. This originates from the fact that Ripple is also designed to function within the interbank SWIFT-network (Tsihitas, 2017).

The high volatility of the selected cryptocurrencies could have its origin in the still significantly high level of uncertainty amongst investors, concerning the whole cryptocurrency market. Even minor negative news and information gathered through media often strongly affect the decisions of investors and can quickly lead to mass selling or mass buying. This often causes a sharp decrease or increase in price, respectively. The fact that Bitcoin is still often only used as a speculative investment, rather than as a medium of exchange, invites a great number of uninformed investors to enter and to leave the Bitcoin market, causing high volatility (Fink & Johann, 2014).

Figure 2: Google Trends of the Selected Cryptocurrencies



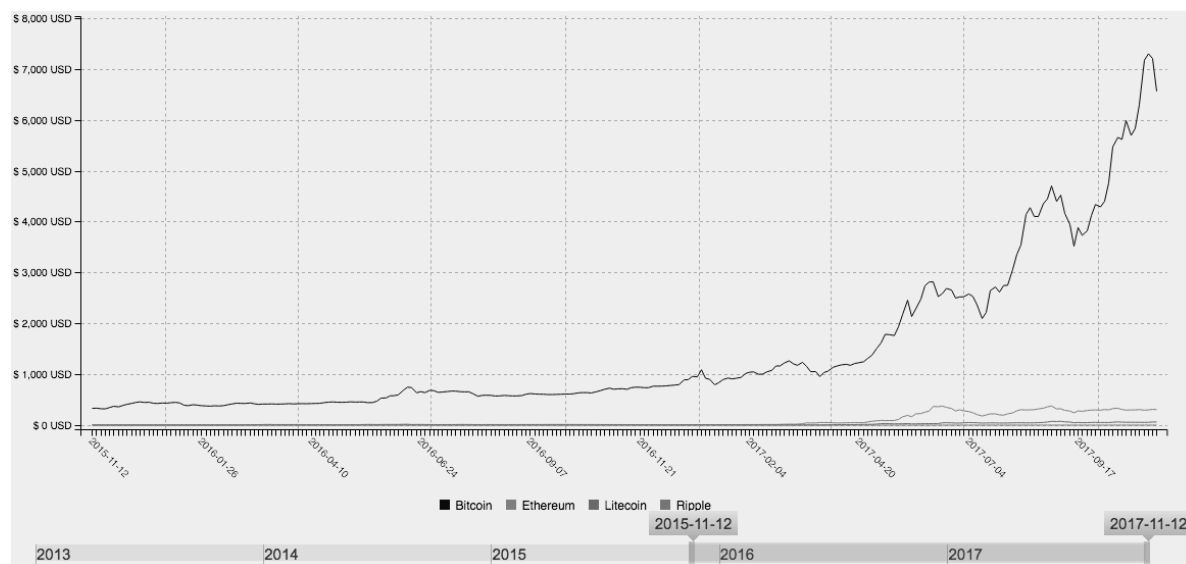
Source: Google Trends, 2017

Enhanced media presence could have had a significant effect on investment activities as well, regarding to Bovaird (2017). The heavy influence of an increased media profile, which could even lead to temporary price bubbles, is also supported by Wang & Vergne (2017). Stenqvist & Lonno (2017), who analyzed if there is a correlation between Bitcoin related Twitter-posts and its price, observed „a partial correlation between binary sentiment and price change for small subsets of data“. Conducting a word count analysis provides another avenue of research. By looking at the Google search interest a high correlation between the price development of each cryptocurrency and the search interest of each cryptocurrency, can be observed. As representative search key words, the names of the different cryptocurrencies were selected. Figure 2 represents the "search interest relative

to the highest point on the chart for the given time" (Google Trends, 2017). Again, the selected time span is November 12, 2015 to November 12, 2017.

By comparing the Google trends to an overlapping chart of the price development of all four selected cryptocurrencies within the same period of time, similar developments can be examined. This shows a high correlation of the growing price and the growing interest (measured by Google searches):

Figure 3: Overlapping Price Developments



Source: CryptocurrencyChart.com

With regards to *liquidity*, we find that all cryptocurrencies are still very volatile in their 24h trade volume up to now. This is strongly influenced by the fact that cryptocurrencies are not yet used for the same purpose as the USD or Euro. Most cryptocurrency investors only use them as a speculative investment (Allerstorfer, 2016). Once one cryptocurrency will be accepted broadly and commonly be used as a medium of exchange, this situation may change. When examining the corresponding movements between liquidity and velocity, at least in case of Bitcoin, a tendency of correlating liquidity and *velocity* can be observed. In 2017, almost every time when liquidity was high, velocity was high too, whereas when liquidity was low, velocity only fell partly. This leads to the conclusion that Bitcoin is on its way to turn from a speculative market towards a mass market.

4 Conclusion

This paper aims to provide an answer to the research question if one of the selected cryptocurrencies fulfils Krugman's three functions of a currency (medium of exchange, unit of account and store of value) and thus could substitute fiat currencies (Krugman, 1984). Therefore, three measures were taken into consideration, namely price development, liquidity and velocity. After analyzing the four cryptocurrencies Bitcoin, Ethereum, Litecoin and Ripple, as well as the newly emerged Bitcoin Cash, we draw the following conclusion. The only cryptocurrency that could in theory fulfil the functions of a currency is Bitcoin Cash, because of two main reasons. First, Bitcoin Cash is truly decentral, meaning that there is no single group or third authority, nor anything that is comparable to a third authority that controls the Bitcoin network. Second, the supply of Bitcoin Cash is fixed with a determined issuance schedule. Both the total supply and the issuance schedule are very unlikely to be altered (Ammous, 2016).

Though Bitcoin (BTC) has these same attributes, there is one big disadvantage of Bitcoin, namely its scalability. Bitcoin has already reached a point where it cannot handle the amount of transactions anymore. This results in high transaction costs and long confirmation times. Fortunately, there is already a solution for this problem. The solution

is called Bitcoin Cash. The blocksize of Bitcoin Cash is adjustable, which means that it is not facing the problem of scalability. Both transaction costs and the duration to verify a transaction will be kept to a minimum (BitcoinCash.org, 2017). This is also in the sense of the original invention of Bitcoin, since it was designed to be a decentral cryptocurrency, that is scalable, if the demand rises (Nakamoto, 2008). As all the other technical specifications of Bitcoin Cash stayed the same as the ones of Bitcoin, Bitcoin Cash could, from a technical point of view, be preferred over Bitcoin.

Ethereum is not in the position to function as a viable substitute to fiat currencies, because there is a small group of miners that could, together with the Ethereum Foundation, control the network of Ethereum and thus function like a third authority in charge. It thus would be less favourable compared to Bitcoin and Bitcoin Cash. Furthermore, Ethereum's purpose is not to be a substitute to fiat currencies, but to provide a platform to ease peer-to-peer activities like smart contracts. Its currency, Ether, was only established to facilitate these activities and not to function as a medium of exchange (Bajpai, 2017).

Although Litecoin is most similar to Bitcoin, it still has a major disadvantage with regard to security. A cryptocurrency that in theory is 100 times easier to be influenced by malicious activity, which could for instance have an impact on the issuance schedule, should never be chosen. Litecoin is also less accepted than Bitcoin globally (Ammous, 2016).

Finally, Ripple is also not in the position to substitute fiat currencies, as it is simply not designed to function as such. The purpose of Ripple is rather to function as an exchange medium between existing currencies. By doing so, it aims to facilitate the current financial system. Ripple also has a company behind it which controls the Ripple network, which is comparable to a central bank (Ripple.com, 2017).

All in all, currently cryptocurrencies are rather tokens and a highly volatile asset class of their own.

References

- Allerstorfer, P. (2016). *Bitcoin, an analysis of the field of a decentralized virtual currency using twitter data*. Linz: JKU Linz. Master Thesis.
- Ammous, S. (2016). *Can Cryptocurrencies fulfil the functions of money? Working Paper No. 92*. Retrieved from: <http://ssrn.com/abstract=2832769>.
- Antonopoulos, A. (2017). *Explaining Bitcoin's 21 Million Supply Cap*. Retrieved from: <http://coinivore.com/2017/08/10/andreas-antonopoulos-explains-bitcoins-21-million-supply-cap>.
- Aru, I. (2017). *Ethereum Price Surge Is Due To One Singular Factor*. Retrieved from: <https://cointelegraph.com/news/ethereum-price-surge-is-due-to-one-singular-factor>.
- Bajpai, P. (2017). *Bitcoin vs Ethereum: Driven by different purposes*. Retrieved from: <https://www.investopedia.com/articles/investing/031416/bitcoin-vs-ethereum-driven-different-purposes.asp>.
- Baker, N., & Leising, M. (2017). *Bitcoin Surges After World's Biggest Exchange Announces Plans for Futures*. Retrieved from: <https://www.bloomberg.com/news/articles/2017-10-31/cme-group-world-s-biggest-exchange-plans-bitcoin-futures>.
- Bech, M., & Garret, R. (2017). Central Bank Cryptocurrencies. *BIS Quarterly Review*, pp. 55-70.
- BitcoinCash.org. (2017). Data retrieved from: <https://www.bitcoincash.org/>.
- Bovaird, C. (2017). *Why Bitcoin Prices Have Risen More Than 400% This Year*. Retrieved: <https://www.forbes.com/sites/cbovaird/2017/09/01/why-bitcoin-prices-have-risen-more-than-400-this-year/>.
- Cermak, Vavrinec (2017). *Can Bitcoin Become a Viable Alternative to Fiat Currencies?*. Retrieved from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2961405.

- Chordia, T., Roll, R., Subrahmanyam, A. (1999). Commonality in liquidity. *Journal of Financial Economics*, vol. 56(1), pp. 3-28.
- Coinmarketcap.com. (2017). *Cryptocurrency Market Capitalizations - USD*. Retrieved from: <https://coinmarketcap.com/>.
- Damodaran, A. (2013). Comatose Markets: What if Liquidity is Not the Norm?. *SSRN Electronic Journal*, retrieved from: <https://ssrn.com/abstract=1729408>.
- Dwyer, G. (2014). The Economics of Bitcoin and Similar Private Digital Currencies. *SSRN Electronic Journal*, retrieved from: <http://ssrn.com/abstract=2434628>.
- EDCAB. (2016). *European Union virtual currency legislation published*. Retrieved from: <http://edcab.eu/blog/european-union-virtual-currency-legislation-published>.
- Ethereum.org. (2017). Data retrieved from: <https://ethereum.org/>.
- ECB. (2012). *Virtual Currency Schemes*. Frankfurt: European Central Bank.
- Fink, C., Johann, T. (2014). *Bitcoin Markets*. Mannheim: University of Mannheim.
- Google Trends. (2017). Quoted from Haiss, P. & Moser, A.
- Haiss, P., Moser, A. (2017). Blockchain-Applications in Banking & Payment Transactions: Results of a Survey. In: *Proceedings of the 14th International Scientific Conference European Financial Systems 2017*. Brno: Masaryk University, part 2, pp. 141-150. ISBN 978-80-210-8609-8, ISBN 978-80-210-8610-4.
- Halaburda, H., & Sarvary, M. (2016). *Beyond bitcoin: The economics of digital currencies*. Retrieved from: <http://www.gbv.de/dms/zbw/828082049.pdf>.
- Harm, J., Obregon, J., Stubbendick, J. (2016). Ethereum vs. Bitcoin. *Economist Case Study*, pp. 3-9.
- Jakes, J. (2016). *Bitcoin - Dutch Tulips or the currency of the future?*. Master Thesis. Retrieved from: <http://fhpub.fh-vie.ac.at/obvbfhs/urn/urn:nbn:at:at-fhbfw:1-1579>.
- Krugman, P. (1984). *The International Role of the Dollar: Theory and Prospect*. National Bureau of Economic Research Inc. Retrieved from: <http://www.nber.org/chapters/c6838.pdf>.
- Lee, L. (2016). New Kids on the Blockchain: How Bitcoin's Technology could reinvet the Stock Market. *Hastings Business Law Journal*, vol. 12(29), pp. 3-36.
- Lehdonvirta, V. (2014). Virtuality in the sphere of economics. In: V. Lehdonvirta, *Oxford Handbook of Virtuality*. Oxford: University Press, pp. 496-510.
- Lybek, T., & Sarr, A. (2002). *Measuring risk in financial markets*. IMF WP No. 02/232.
- Malliaris, A. (2005). *The Global Monetary System: Its Weaknesses and the Role of the IMF, the EU and NAFTA A*.
- Merkel, K. (2017). *Kryptowährungen: ICO-Verbot schlägt Wellen*. Handelszeitung.
- Möbert, J. (2018). *Bitcoin: Myths, misconceptions and misunderstandings*. Retrieved from: https://www.dbresearch.com/PROD/RPS_EN-PROD/PROD0000000000461636/Bitcoin%3A_Myths%2C_misconceptions_and_misunderstandin.pdf.
- Nakamoto, S. (2008). *Bitcoin: A Peer-to-Peer Electronic Cash System*. Retrieved from: <https://bitcoin.org/bitcoin.pdf>.
- Osterrieder, J., Chan, S., Chu, J., & Nadarjah, S. (2017). The Statistical Analysis of Cryptocurrencies. *SSRN Electronic Journal*, retrieved from: <https://ssrn.com/abstract=2948315>.
- Reiff, N. (2017). *What Caused the Ethereum Price Crash This Week?*. Retrieved from: <https://www.investopedia.com/news/ethereum-price-crash-vitalek-buterin/>.
- Ripple.com. (2017). Data retrieved from: <https://ripple.com>.

Rizzo, Peter (2017). *Bitcoin Price Drops Below \$2,000 as Crypto Markets Fall Toward \$70 Billion*. Retrieved from: <https://www.coindesk.com/bitcoin-price-drops-near-2000-crypto-markets-fall-toward-70-billion/>.

Russo, C. (2017). *Bitcoin Plunges After Plans for Split Called Off*. Retrieved from: <https://www.bloomberg.com/news/articles/2017-11-10/bitcoin-slumps-as-developer-community-remains-divided>.

Swan, M. (2015). *Blockchain, Blueprint for a New Economy*. O'Reilly Media.

Tsihitas, T. (2017). *Ripple vs Bitcoin Comparison*. Retrieved from: <https://coincentral.com/ripple-vs-bitcoin/>.

Tymoigne, E., & W., L. Randall (2005). Money: An alternative Story. *University of Missouri Working Paper*, No. 45, pp. 2-17.

Waters, J. (2017). Virtual currency law in the United States. Retrieved from: https://en.wikipedia.org/wiki/Virtual_currency_law_in_the_United_States.

Wikipedia. (2018). *List of cryptocurrencies*. Retrieved from: https://en.wikipedia.org/wiki/List_of_cryptocurrencies.

Specifics of the Reporting under International Accounting Standard IAS 41 Agriculture and its Usage on the Central European Stock Exchanges

Filip Hampl

Masaryk University
Faculty of Economics and Administration, Department of Finance
Lipová 41a, 602 00 Brno-Pisárky, Czech Republic
E-mail: filip.hampl@mail.muni.cz

Abstract: *Companies listed on stock exchanges in the European Union prepare and present their financial reports mostly in accordance with International Financial Reporting Standards (IAS/IFRS). International Accounting Standard IAS 41 Agriculture, prescribing the accounting treatment and disclosures related to biological assets used for agricultural activity, is an integral part of these standards. The need of the particular standard for agriculture stands from the specific character of agricultural activity based on the biological transformation of living organisms – plants and animal beings. This paper deals with the specific areas of the accounting treatment incorporated in the International Accounting Standard IAS 41. Furthermore, it examines whether there are agriculture companies reporting in accordance with IAS 41 among corporations publicly listed on the stock exchanges in the Czech Republic, in Slovakia, Poland, Hungary and Austria. Results show that only small number of agriculture companies is listed on the Central European stock exchanges. Therefore, there is the low usage of IAS 41. Although IAS 41 might seem redundant, it has its importance consisting in the specific accounting treatment that cannot be substituted by other standards.*

Keywords: *agriculture company, biological assets, financial reporting, IAS/IFRS, stock exchange*

JEL codes: *M41, Q14*

1 Introduction

Agriculture represents a specific sector of the national economy. Agriculture companies differ within the meaning of nature of their activities from other business entities. Bohušová et al. (2012) mention that agricultural activity is in comparison with other activities of business subjects dependent on the natural and environmental conditions (geographic condition, weather, etc.). According to Dvořáková (2014), agricultural activity takes place independently of human activities due to the biological characteristic of assets, such as vegetation period, pollination by specific species, multi-annual length of the production cycle. People can only facilitate or influence biological transformation by enhancing or stabilizing conditions necessary for the process to take place (e.g. moisture, temperature, fertility and light). Sedláček (2010) claims that in comparison with other economic branches, the agricultural activity is characterized by specific activities that require the appropriate accounting attitudes. This is also confirmed by Bohušová et al. (2012) who mention that the specifics of the biological character of transformation should be reflected by the methodology for reporting for activities of agriculture companies. According to Dvořáková (2012), nature of agricultural activity based on biological transformation (comprising growth, degeneration, production, etc.) that changes the substance of biological asset, is difficult to capture in traditionally used accounting models established on historical costs and realization principle.

On the international level of accounting and financial reporting particularities of agricultural activity are treated in the International Accounting Standard 41 Agriculture (IAS 41). The objective of IAS 41 Agriculture is to prescribe the accounting treatment and disclosures related to agricultural activity. IAS 41 should be considered "lex specialis" to other "lex generalis" International Financial Reporting Standards (IAS/IFRS). Although it is dedicated to agriculture, it does not treat accounting of agricultural sector as a whole. It only deals

with the accounting treatment of specific assets related to agriculture, mainly with their particular measurement. Other accounting matters of agriculture companies are prescribed by other IAS/IFRS.

2 Methodology and Data

This paper aims to present specific accounting treatment of agricultural activity incorporated in the International Accounting Standard 41 Agriculture and find out whether there are agriculture companies reporting in accordance with IAS 41 among publicly listed corporations on the stock exchanges in the Czech Republic, in Slovakia, Poland, Hungary and Austria.

This paper is based on an analysis of the International Accounting Standard 41 Agriculture, other relevant International Financial Reporting Standards and appropriate literature sources, articles and monographs. To discover publicly listed companies applying IAS 41, the data from the stock exchanges and corporations' annual or quarterly reports from the year 2017 is used. All stock market segments of the following stock exchanges are selected for the research:

- Prague Stock Exchange (Burza cenných papírů Praha),
- Bratislava Stock Exchange (Burza cenných papierov v Bratislavě),
- Warsaw Stock Exchange (Giełda Papierów Wartościowych w Warszawie),
- Budapest Stock Exchange (Budapesti Értéktőzsde) and
- Vienna Stock Exchange (Wiener Börse).

The methods of description, analysis, synthesis and deduction will be applied in this paper. The conclusion will assess the necessity of IAS 41 regarding specific assets related to agricultural activity.

3 Results and Discussion

IAS 41 is applied to account for biological assets, agricultural produce at the point of harvest and government grants related to agricultural activity. IAS 41 does not deal with agricultural produce after harvest and its processing, for example, the processing of sugarcane into sugar, harvested cotton into thread or picked tea leaves into tea, although such processing may be a logical and natural extension of agriculture activity or there should be a certain perceptible similarity to biological transformation. IAS 2 or another suitable standard applies to harvested produce in dependence on the course of its use.

On the other hand, IAS 41 cannot be applied to assets which are in the scope of other standards, such as land related to agricultural activity (IAS 16 Property, Plant and Equipment), intangible assets related to agricultural activity (IAS 38 Intangible Assets), right-of-use assets arising from a lease of land related to agricultural activity (IFRS 16 Leases).

Standard defines used terms; for purposes of this paper, only the most important definitions will be mentioned. Under the *agricultural activity*, IAS 41 understands management by an entity of the biological transformation and harvest of biological assets for sale or conversion into agricultural produce or additional biological assets with *biological asset* defined as a living animal or plant. Based on this definition, agricultural activity covers a diverse range of activities, e.g. forestry, annual or perennial cropping, cultivating orchards and plantation, fish farming or cattle farming. *Agricultural produce* is the harvested product of the entity's biological assets. Three common features can be identified within this diversity – biological asset capability of biological transformation (growth, degeneration, production and procreation), conditions management of biological transformation and measurement of qualitative and quantitative changes brought about by biological transformation or harvest.

Recognition and measurement

Recognition and measurement are the pivotal part of IAS 41, such as other standards. In compliance with the common definition of assets included in the Conceptual Framework, an entity shall recognize biological assets or agricultural produce only when:

- a) an entity controls the asset as a result of past events,
- b) it is probable that future economic benefits associated with the asset will flow to the entity, and
- c) the fair value or cost of the asset can be measured reliably.

IAS 41 requires all biological assets related to agricultural activity to be measured on initial recognition and at the end of each reporting period at *fair value less costs to sell* where costs to sell are defined as incremental costs directly attributable to the disposal of an asset, excluding finance costs and income taxes. Agricultural produce harvested from an entity's biological asset is measured at its fair value less costs to sell at the point of harvest. Such measurement is the cost at that date when applying IAS 2 Inventories or another applicable standard.

There is a presumption that fair value can be measured reliably for a biological asset. That presumption can be rebutted only on initial recognition for a biological asset for which quoted market prices are not available and for which alternative fair value measurements are determined based on professional judgement to be clearly unreliable. Only in such case, entity measures the biological assets at its acquisition cost less any accumulated depreciation and any accumulated impairment. Once the fair value of biological asset becomes reliable, an entity measures it at its fair view less costs to sell. IAS 41 allows that acquisition/production costs may approximate fair value, particularly when only little biological transformation has taken place since initial cost incurrence, or the impact of the biological transformation is immaterial. An entity that has previously measured a biological asset at its fair value less costs to sell is obligated to continue in this type of its measurement.

Measurement prescribed by IAS 41 is based on the principle that the biological transformation that these assets undergo during their lifespan is best reflected by fair value measurement (IFRS Foundation, 2014). Evaluating the agricultural activity at the point of the harvest results from the fact that the transformation process is immediately represented in the financial statements and due to the fact that the stakeholders are able to estimate the future economic benefits (Lefter, Roman, 2007). The fair value of biological assets has the direct relation to changes in anticipating the future benefits. For example, anticipated benefits are directly proportional to the growth of trees in the forest (Dvořáková, 2012). On the other hand, the evaluation at the acquisition/production cost does not reflect sufficiently the increase in value during development phase over the time of growth of biological asset due to the small relation between expended costs and growth of biological assets, e.g. trees in the forest (Lefter, Roman, 2007). Entities using the evaluation at historical cost cannot recognize the revenue until the harvest or sale (it could take decades in case of trees). By using fair value evaluation model, gains can be recognized continuously during each accounting period until the harvest.

Fair value determination

At the time of its creation, IAS 41 contained a definition of fair value and the options of its determination. Since a new International Financial Reporting Standard 13 Fair Value Measurement was approved (effective from 1st January 2013), its definition of fair value is currently prescribed for all standards. IFRS 13 defines *fair value* as a price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. That definition of fair value emphasizes that fair value is a market-based measurement (i.e. market approach), not an entity-specific measurement (Stárová et al., 2016). According to Dvořáková (2012), active market with biological assets, especially with long-term production cycle, may not function. For that reason, other approaches to fair value (i.e. cost or income approach) offered by IFRS 13

have to be employed. In that case, Svoboda, Bohušová (2017) and Cavalheiro et al. (2017) suggest using discounted cash flow (income approach) to measure biological asset's fair value. But it should be noted that any cash flow for financing the assets, taxation, or re-establishing biological assets after harvest, e.g. the cost of replanting trees in a plantation forest after harvest, cannot be included in the calculation (IAS 41).

An entity should use maximally relevant and observable information in order to measure fair value. IFRS 13 specifies the hierarchy of inputs in the determination of fair value using valuation approaches mentioned above. Level 1 inputs are considered the most reliable evidence of fair value and have to be used without adjustment to measure fair value whenever available; it has the highest priority. Level 1 inputs are quoted prices in active market for identical assets on the principal or the most advantageous market for the asset. Related to biological assets Dvořáková (2014) points out that market prices often have unstable seasonal character – they can differ significantly at the end of reporting period from future sale prices, which could cause recognition of unrealized gains or losses. These unrealized gains could be a subject of taxation (Bartůňková, Semerád, 2013). Level 2 inputs are directly or indirectly observable quoted prices in active markets for similar assets or, in case of missing active markets, quoted prices for identical or similar assets in markets that are not active. Level 3 inputs are unobservable on the markets. They reflect management's own assumptions about the assumptions market participants would use in pricing the asset (including risk assumptions). At level 3 the asset valuation requires a certain degree of judgment by the appraiser, and this could influence reliability and relevance of the generated information (Yang et al., 2005).

Reporting

Biological assets are reported as non-current or current assets in the balance sheet. A gain or a loss arising on initial recognition of a biological asset or agricultural produce at fair value less costs to sell and from a change in fair value less costs to sell is included in the profit or loss for the period in which it arises (IAS 41). A loss might arise on initial recognition of a biological asset because costs to sell are deducted, and they can exceed the fair value of the asset. Gains and losses are compensated and reported separately from other costs/losses and revenues/gains in the statement of comprehensive income.

Governments Grants

Accounting approach related to government grants incorporated in IAS 41 differs from an approach in IAS 20 Accounting for Government Grants and Disclosure of Government Assistance. The common approach to grants based on deducting a grant from the carrying amount of the related asset would be inconsistent with fair value model. (Dvořáková, 2014). For that reason, IAS 41 incorporates its own treatment

Unconditional grants related to biological assets measured at fair value less costs to sell are recognized in income when the government grant becomes available. Conditional grants are recognized in income when the conditions related to the government grant are met. If the terms of the grant allow part of it to be retained according to time that has elapsed, the entity recognized that part in profit or loss as time passes (IAS 41).

Bearer Plants

Beside biological assets mentioned above, IAS 41 distinguishes a specific group of biological assets called bearer plants that differ from other biological assets. Bearer plants are used solely to grow produce over several periods and at the end of their productive lives accounting unit usually gets rid of them. Once bearer plant attains maturity its biological transformation is no longer significant in generating future economic benefits. The only significant future economic benefits of bearer plant come from the agricultural produce that it generates (IFRS Foundation, 2014). In other words, once they are mature and productive, they are similar to "machinery used for manufacturing of goods". IAS 41 defines the bearer plant as a living plant that:

- a) is used in the production or supply of agricultural produce;

- b) is expected to bear produce for more than one period; and
- c) has a remote likelihood of being sold as agricultural produce.

Originally the rules of IAS 41 were applied on bearer plants as well. But based on feedback from stakeholders who argued that fair value measurement was not appropriate for these bearer biological assets (Deloitte, 2014), the International Accounting Standards Board (IASB) has decided to change their accounting treatment. On 30th June 2014, IASB issued Agriculture: Bearer Plants (Amendments to IAS 16 and IAS 41) effective for entities since annual periods beginning on or after 1st January 2016. IASB decided that bearer plants will be within the scope of IAS 16 Property, Plant and Equipment and be a subject to all requirements therein. This includes the option to choose between the cost model and revaluation model for subsequent measurement (EY, 2014).

Plants like tea bushes, grape vines, oil palms and rubber trees usually meet the definition of a bearer plant and are within the scope of IAS 16. However, it is necessary to mention that the produce growing on bearer plants – for example, tea leaves, grapes, oil palm fruit or latex – remains within the scope of IAS 41. Annual crops and other plants that held solely to be harvested as agricultural produce, such as soya, wheat and soya or trees grown for lumber, are not expected to meet the definition of bearer plants. In addition, biological assets with dual use, both bearer (e.g. fruit) and consumable (e.g. lumber) attributes do not hold the definition and remain under the rules of IAS 41 (EY, 2014). Bearer animals are explicitly excluded from the definition and are accounted for under IAS 41.

Bearer plants that are subject to IAS 36 have to meet all measurement requirements in IAS 16. Before maturity, bearer plants will be measured at their accumulated cost, in the same way as self-constructed items of property, plant and equipment before they are in the location and condition necessary to be capable of operating in the manner intended by management. After they become mature, entities choose to measure either the cost model or the revaluation model. Following either model, entities have to determine the useful life of the bearer plant in order to depreciate it. The useful life needs to be re-evaluated each year. Unlike biological assets under IAS 41, property, plant and equipment under IAS 16 are not scoped out of IAS 36 Impairment of Assets – this means the need for assessing whether there are some indicators that bearer plants are impaired at the end of the accounting period.

Usage of IAS 41 on the Central European Stock Exchanges

Regulation (EC) No. 1606/2002 requires that all publicly listed companies on a regulated market in the European Union have to prepare their consolidated financial statements in accordance with IFRS. Member states can still decide on the obligation to apply IFRS for the preparation of individual financial statements of publicly listed companies on a regulated market. In case of corporations traded on a non-regulated market (i.e. multilateral trading facility) responsible market organizer (stock exchange) decides on using IFRS. For example, in the Czech Republic, all publicly listed companies on the regulated market have to prepare their financial statements (individual or consolidated) in accordance with IFRS (Act No. 563/1991 Coll.). On the contrary, in Slovakia only some publicly listed companies on the regulated market have to applied IFRS for their individual financial statements (e.g. banks, insurance companies or reinsurance companies), the others may (but do not have to) use IFRS (Act No. 431/2002 Coll.). Both countries do not regulate using IFRS on non-regulated markets.

Application of IAS 41 supposes that entity is involved in the agricultural activity and prepares its financial statements in accordance with IFRS. The examination of using IAS 41 was conducted among corporations on regulated and non-regulated stock market segments of the Central European Stock Exchanges. The results presented in Table 1 show that only the low number of publicly listed companies uses IAS 41. In total, 1 653 listed companies were examined, and only 19 of them use IAS 41.

Table 1 Usage of IAS 41 on the Central European Stock Exchanges

Stock Exchange	Total number of publicly listed companies	Number of companies using IAS 41	Companies using IAS 41 (%)
Prague Stock Exchange	53	1	1.887
Bratislava Stock Exchange	60	1	1.667
Warsaw Stock Exchange	880	13	1.477
Budapest Stock Exchange	40	0	0.000
Vienna Stock Exchange	620	4	0.645
Total	1 653	19	1.149

Source: Own arrangement based on the data retrieved from the Central European stock exchanges and financial statements of listed corporations

The low usage of IAS 41 can be explained by the small number of publicly listed agriculture companies on the stock exchanges. Most agriculture companies are small, independent, cash and tax-focused, family-operated business units, without the need to obtain capital on stock exchanges (Dvořáková, 2012). According to Eurostat (2013), there were 10.8 million farms across the EU-28. There is a large number (4.9 million) of very small, family farm (less than 2 hectares in size), and a small number (0.3 million) of very large farms (over 100 hectares). Apart from the size, Messah (2011) found out that agriculture companies in relation to listing on stock exchanges face major challenges such as high listing fees, price instability and fluctuations for agricultural produce based on inconsistent weather conditions or fluctuations in profitability in the agricultural sector, hence considered a risky sector to invest in. These reasons can explain the low listing of these companies as well.

Another reason for the results can be found in the state law and stock exchange rules which do not require IFRS application for all listed companies. Agriculture companies are traded particularly on non-regulated market segments where the stock exchanges often do not prescribe mandatory using IFRS. Given the additional costs related to IFRS adoption (e.g. Navarro-García and Bastida, 2010, or Morris et al., 2014) companies are not motivated to apply them. Therefore, not every entity from the small amount of listed agriculture companies uses IAS 41. On the other hand, with continuing globalization and increasing pressure on international comparability of financial statements by owners, potential investors, financial institutions or regulators it can be assumed that the importance of IFRS will rise and agriculture companies will be more motivated to start preparing their financial statements in accordance with IFRS.

Although at first sight, it might seem that IAS 41 is redundant due to its low usage, it is not the case. It provides accountants with coherent, logically structured and understandable set of specific rules that cannot be substituted by other existing IAS/IFRS. Thanks to these rules agriculture companies are able to prepare reliable, transparent and internationally comparable financial statements with respect to their activity based on biological transformation.

4 Conclusion

Agricultural companies differ regarding their activities from the other business corporations. Their activity is based on the biological transformation that is dependent on the natural and environmental conditions and takes independently of human activities – people can only facilitate or influence it. The nature of the agricultural activity is difficult to capture in traditionally used accounting models based on historical cost and realization principle (Dvořáková, 2012).

International Accounting Standard 41 offers the special accounting treatment of biological assets (except bearer plants), agricultural produce at the point of harvest and government grants related to agricultural activity. IAS 41 is based on the fair value principle which represents the best way how to capture the biological transformation in the accounting

books and financial statements because the fair value has the direct relation to changes in anticipating the future benefits. For that reason, IAS 41 requires all biological asset and agricultural produce to be measured at fair value less costs to sell if fair value is reliably measurable. Determination of fair value is incorporated in IFRS 13 which prescribes three fair value determination approaches (market, cost and income) and three levels of applicable input information.

Based on the conducted research among 1 653 publicly listed corporations on the stock exchanges in the Czech Republic, in Slovakia, Poland, Hungary and Austria, there is the only small number of agriculture companies using IAS 41. Although its low usage might suggest its uselessness, it provides a specific set of accounting rules that cannot be found in any other standard, and that is important for agriculture companies (non-listed as well). IAS 41 allows them to prepare financial statements with respect to particularities of the biological transformation based on comparable, internationally known, uniform and reliable accounting rules and principles. It can be expected that continuance of globalization increases the importance of International Financial Reporting Standard even more for owners, potential investors, banks or government agencies and more (not only) agriculture companies will begin to apply IFRS.

Acknowledgements

This contribution was created with the support of Masaryk University within the project of the specific research MUNI/A/0904/2017 "Performance Evaluation of Agricultural Companies".

References

Act No. 431/2002 Coll., on Accounting, as amended. The Slovak Republic.

Act No. 563/1991 Coll., on Accounting, as amended. The Czech Republic.

Bartůňková, L., Semerád, P. (2013). Use of fair value in agriculture. In: *PEFnet 2013*. Brno: Mendelova univerzita.

Bohušová, H., Svoboda, P., Nerudová, D. (2012). Biological assets reporting: Is the increase in value caused by the biological transformation revenue?. *Agricultural Economics*, vol. 58(11), pp. 520-532.

Cavalheiro, R. T., Kremer, A. M., Gimenes, R. M. T. (2017). Fair Value for Biological Assets: An Empirical Approach. *Mediterranean Journal of Social Sciences*, vol. 8(3), pp. 55-68.

Conceptual Framework. International Accounting Standards Board, 2010.

IAS 41, *Agriculture*, as amended. International Accounting Standards Board, 2000.

Deloitte (2014). *IFRS in Focus: IASB amends IAS 16 and IAS 41 to include bearer plants within the scope of IAS 16 instead of IAS 41*. Retrieved from: <https://www.iasplus.com/en/publications/global/ifrs-in-focus/2014/ias-41-ias-16>

Dvořáková, D. (2012). *Specifika účetnictví a oceňování v zemědělství*, 1st ed. Praha: Wolters Kluwer ČR.

Dvořáková, D. (2014). *Finanční účetnictví a výkaznictví podle mezinárodních standardů IFRS*, 4th ed. Brno: Albatros Media.

Eurostat (2013). *Farm structure survey 2013 – main results*. Retrieved from: http://ec.europa.eu/eurostat/statistics-explained/index.php/Farm_structure_survey_2013_-_main_results

EY (2014). *Bearer plants – the new requirements*. Retrieved from: [http://www.ey.com/Publication/vwLUAssets/IFRS_Developments_Issue_84:_Bearer_plants_-_the_new_requirements/\\$FILE/Devel84-Agriculture-July2014.pdf](http://www.ey.com/Publication/vwLUAssets/IFRS_Developments_Issue_84:_Bearer_plants_-_the_new_requirements/$FILE/Devel84-Agriculture-July2014.pdf).

- IFRS Foundation (2014). *IASB issues amendments to IAS 16 and IAS 41 for bearer plants*. Retrieved from: <http://archive.ifrs.org/Alerts/Publication/Pages/IASB-issues-amendments-to-IAS-16-and-IAS-41-for-bearer-plants-June-2014.aspx>.
- Messah, O. B. (2011). Reasons for Low Listing by Agricultural Companies in the Bourse: A Case Study of Del Monte Limited Kenya. *Research Journal of Finance and Accounting*, vol. 2(3), pp.56-70.
- Morris, R. D., Gray, S. J., Pickering, J., Aisbitt, S. (2014). Preparers' perceptions of the costs and benefits of IFRS: Evidence from Australia's Implementation Experience. *Accounting Horizons*, vol. 28(1), pp. 143-173.
- Navarro-García, J. C., Bastida, F. (2010). An empirical insight on Spanish listed companies' perceptions of international financial reporting standards. *Journal of International Accounting, Auditing and Taxation*, vol. 19(2), pp. 110-120.
- Lefter, V., Roman, A. G. (2007). IAS 41 Agriculture: Fair Value Accounting. *Theoretical and Applied Economics*, vol. 5, pp. 15-22.
- Sedláček, J. (2010). The methods of valuation in agricultural accounting. *Agricultural Economics*, vol. 56(2), pp. 59-66.
- Stárová, M., Čermáková, H., Hlavsa, T., Vostrovská, H., Levá M. (2016). Evaluation of applicability of IAS 41 – Agriculture to the valuation of growing forest stands and their accounting treatment in the Czech Republic. *Journal of Forest Science*, vol. 62(9), pp. 429-440.
- Svoboda, P., Bohušová, H. (2017). Amendments to IAS 16 and IAS 41: Are there any differences between plant and animal from a financial reporting point of view?. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, vol. 65, pp. 327-337.
- Yang, Z., Rohrbach, K., Chen, S. (2005). The Impact of Standard Setting on Relevance and Reliability of Accounting Information: Lower of Cost or Market Accounting Reforms in China. *Journal of International Financial Management and Accounting*, vol. 16(3), pp. 194-228.

Volatility Model Based GARCH Minimum Variance Hedging

Haochen Guo

VŠB-Technical University of Ostrava
Faculty of Economics, Department of Finance
Sokolská třída 33, 702 00 Ostrava, Czech Republic
E-mail: haochen.guo@vsb.cz

Abstract: In the risk management, volatility as the important parameter for estimation in the issue of hedging. Volatility model is the regression based forecasting model. GARCH (Generalized Autoregressive Conditional Heteroscedasticity) model is one of volatility model, it presents the variance rate at the current time step is a weighted average of a constant long run average variance rate, the variance rate at the previous time steps and the most recent information about the variance rate. Hence, there are many literatures supposed to use the GARCH minimum variance hedging the financial derivatives. Thus, the bivariate GARCH model provides a superior performance to other dynamic or constant hedge for financial derivatives. In the paper, it estimates the minimum variance hedge based on an advanced econometric model (GARCH model) with time varying minimum variance hedge.

Keywords: Volatility Model, GARCH Model, minimum variance, hedge ratio

JEL codes: C01, G17, G32

1 Introduction

The forecasting of volatility can be regarded as a significant problem of financial modelling. Because the volatility is an important parameter for financial risk management and it is applied in many issues such as option pricing, portfolio optimization, Value at Risk, hedging and so on. There are many literatures supposed to use the GARCH minimum variance hedging the financial derivatives. Hence, in this paper analyzes the volatility model applies to hedging – GARCH minimum variance hedging.

2 Methodology Volatility Model based GARCH Minimum Variance Hedge

This section describes the minimum variance hedge (section 2.1), the volatility forecasting - GARCH model (section 2.2) and GARCH minimum variance hedge ratio (section 2.3).

Minimum Variance Hedge

Suppose there is a maturity mismatch, so that the hedge position is closed at some time $t < T$, where T is the expiry date of the futures. The value of the hedged portfolio at time t is

$$P(t) = n \times N_F \times F(t, T) - N_S \times S(t). \quad (1)$$

The variance of this portfolio value is

$$\text{Variance}(P(t)) = n^2 N_F^2 \text{Variance}(F(t, T)) + N_S^2 \text{Variance}(S(t)) - 2n N_F N_S \text{Cov}(F(t, T), S(t)). \quad (2)$$

Note that if $n N_F = N_S$ as in the one-for-one hedge then

$$\text{Standard Deviation}(P(t)) = N_S \times \sqrt{\text{Variance}(F(t, T)) + \text{Variance}(S(t)) - 2\text{Cov}(F(t, T), S(t))}. \quad (3)$$

The hedging criterion is to choose n at time 0 to minimize equation (2). Differentiating with respect to n and checking the second order condition gives the optimal number of contracts in the hedge as

$$n^* = \left(\frac{N_S}{N_F}\right) \times \beta^*, \quad (4)$$

where

$$\beta^* = \frac{Cov(F(t,T),S(t))}{Variance(F(t,T))}. \quad (5)$$

The ratio equation is called the minimum variance hedge ratio.

Verification of the financial risk estimation approaches following the minimum variance hedging under partial risk, which expressed variable parameter $r \in (0; 1]$. The parameter r means, what part of the risk should be hedged. If the r equal 1, it means the whole risk is hedged, if it is less than 1, it is only a partial hedged. Hence, the minimum variance partial hedge ratio expressed by following equation

$$\beta_r^* = \frac{r * Cov(F(t,T),S(t))}{Variance(F(t,T))}. \quad (6)$$

Estimating Volatility - The GARCH Model

Define σ_t as the volatility of a market variable on day t , as estimated at the end of day $t-1$. The square of the volatility on day t σ_t^2 is the variance rate.

To estimate the volatility of a stock price empirically, the stock price is usually observed at fixed intervals of time.

$$R_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \text{ for } i=1,2,\dots,t. \quad (7)$$

Where, $t+1$: Number of observations,

$P_{i,t}$: Stock price at end of i th interval ($i=0,1,\dots,t$).

Because $P_i = P_{i-1}e^{R_i}$, R_i is the continuously compounded return in the i th interval. The usual estimate, P , of the standard deviation of the σ_i 's is given by

$$\sigma_i = \sqrt{\frac{1}{N-1} \sum_{i=1}^n [R_{i,t} - E(R_i)]^2} = \sqrt{\sigma_i^2}, \quad (8)$$

Where $E(R_i)$ is the mean of the $R_{i,t}$'s.

$$\ln \frac{P_T}{P_0} \sim \phi\left[\left(R_{i,t} - \frac{\sigma^2}{2}\right)T, \sigma\sqrt{T}\right], \quad (9)$$

Following that σ itself can be estimated as σ^* .

$$\sigma^* = \frac{P}{\sqrt{\tau}}, \quad (10)$$

The standard error of this estimate can be shown to be approximately $\sigma^* / \sqrt{2t}$.

Suppose that the value of the market variable at the end of day i is P_i . The variable R_i is defined as the continuously compounded return during day i .

$$R_i = \ln \frac{P_i}{P_{i-1}}, \quad (11)$$

An unbiased estimate of the variance rate per day, σ_i^2 using the most recent n observations on the R_i is

$$\sigma_t^2 = \frac{1}{N-1} \sum_{i=1}^N [R_{t-1} - E(R_i)]^2, \quad (12)$$

Where $E(R_i)$ is the mean of the R_i 's:

$$E(R_i) = \frac{1}{N} \sum_{i=1}^N R_{t,i}, \quad (13)$$

For the purposes of calculating Value at Risk, the formula in equation (13) is usually changed in a number of ways $R_i, E(R_i), N-1$.

Where R_i is defined as the proportional change in the market variable between the end of day $i-1$ and the end of day i so that

$$R_i = \frac{P_i - P_{i-1}}{P_{i-1}}, \quad (14)$$

$E(R_i)$ is assumed to be zero and $N-1$ is replaced by t .

The formula for variance rate becomes

$$\sigma_t^2 = \frac{1}{N} \sum_{i=1}^N R_{t-i}^2, \quad (15)$$

The Generalized Autoregressive Heteroskedastic (GARCH) model is developed by Engle (1982) and Bollerslev (1986).

In GARCH model, σ_t^2 is calculated from a long-run average variance rate, as well as from σ_{t-1} and R_{t-1} . The equation for GARCH is

$$\sigma_t^2 = \gamma \sigma_t^2 + \alpha R_{t-1}^2 + \beta \sigma_{t-1}^2, \quad (16)$$

Where, α is the weight assigned to R_{t-1}^2 , and β is the weight assigned to σ_{t-1}^2 . Because the weights must sum to one:

$$\gamma + \alpha + \beta = 1, \quad (17)$$

Setting $\omega = \gamma V$, the GARCH model in following equation,

$$\sigma_t^2 = \omega + \alpha R_{t-1}^2 + \beta \sigma_{t-1}^2, \quad (18)$$

This is the form of the model that is usually used for the purposes of estimating the parameters. Once ω, α, β have been estimated, it can calculate γ as $1 - \alpha - \beta$. The long-term variance can then be calculated as ω / γ . For a stable GARCH process it requires $\alpha + \beta < 1$. Otherwise the weight applied to the long-term variance is negative.

The GARCH Minimum Variance Hedge

This is the number of futures contracts in the hedge when minimize the variance of the hedge portfolio. Note that when beliefs are expressed in terms of returns normally express the minimum variance hedge ratio as

$$\tilde{\beta} = \rho \frac{\sigma_S}{\sigma_F}. \quad (19)$$

It estimated by performing a simply linear regression by OLS. The regression model is

$$r_{St} = \alpha + \tilde{\beta} r_{Ft} + \varepsilon_t, \quad (20)$$

where the dependent variance is the return on the portfolio to be hedged and the independent variable is the return on the hedging instrument.

Time varying minimum variance hedge ratios may also be estimated using a bivariate GARCH model. These models extension to time varying minimum variance hedge ratios is not entirely straightforward, since it is typical that the portfolio will be cointegrated with its hedging instrument.

The disequilibrium term in the error correction mechanism will be closely approximated by the fair value of the basis. To see why, note that

$$\ln F^*(t, F) - \ln S(t) = (r - y)(T - t) = C(t, T). \quad (21)$$

Although $C(t, F)$ will be stationary when the spot and futures are cointegrated, which they are when the basis is mean-reverting, it need not be the most stationary linear combination of the log of the market price of the futures and the log of the spot time. nevertheless since the mispricing of the futures contract relative to its fair value is so small it is reasonable to assume the error correction term in the error correction model is equal to $C(t, T)$ when log returns rather than returns are used in the GARCH model.

Introducing the notation

$$y_t = \begin{pmatrix} r_{St} \\ r_{Ft} \end{pmatrix}, \mu = \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix}, \pi = \begin{pmatrix} \pi_1 \\ \pi_2 \end{pmatrix}, \Gamma = \begin{pmatrix} \Gamma_{11} & \Gamma_{12} \\ \Gamma_{21} & \Gamma_{22} \end{pmatrix} \text{ and } \varepsilon_t = \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{pmatrix}, \quad (22)$$

where the vector y contains log returns, it can write the conditional mean equations as

$$y_t = \mu + \Gamma y_{t-1} + \pi C_{t-1} + \varepsilon_t. \quad (23)$$

In the conditional bivariate GARCH framework, it assumes $\varepsilon_t | I_{t-1} \sim N(0, H_t)$ where I_{t-1} denotes the information set as time $t - 1$ and $H_t = \begin{pmatrix} \sigma_{St}^2 & \sigma_{SFt} \\ \sigma_{SFt} & \sigma_{Ft}^2 \end{pmatrix}$,

where σ_{St} and σ_{Ft} are the conditional standard deviations of the portfolio and the hedging instrument and σ_{SFt} is their conditional covariance at time t . This matrix is called the conditional covariance matrix. The GARCH minimum variance hedge ratio at time t is then given by

$$\tilde{\beta}_t = \frac{\sigma_{SFt}}{\sigma_{Ft}^2}. \quad (24)$$

Note that the GARCH model hedge ratio is time varying as well as its estimate.

Verification of the financial risk estimation approaches following the GARCH minimum variance partial hedging under partial risk, which expressed variable parameter $r \in (0; 1]$. The parameter r means, what part of the risk should be hedged. If the r equal 1, it means the whole risk is hedged, if it is less than 1, it is only a partial hedged. Hence, the GARCH minimum variance partial hedge ratio expressed by following equation

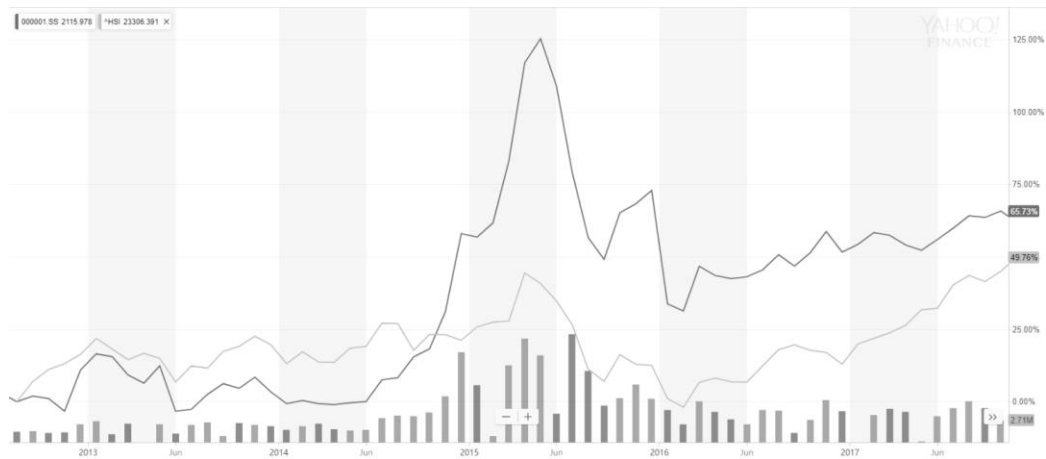
$$\tilde{\beta}_t = \frac{r \sigma_{SFt}}{\sigma_{Ft}^2}. \quad (25)$$

3 Empirical Study of Volatility Model based GARCH minimum Variance Hedge

This section illustrates the minimum variance hedge ratio (section 3.1) and GARCH minimum variance hedge as the empirical research with two Chinese indices (section 3.2).

Minimum Variance Hedge Ratios

Illustrate that based on the equation (5), (6) and (20) to calculate the OLS minimum variance futures hedge ratios for the two Chinese indices (Figure 1) of SSE composite index (000001.SS), HANG SENG index (^HSI) that according to the hedging period of 1 day (daily data). The following Table 1 presents the results of minimum variance hedge ratios from 23th July 2012 – 13th October 2017.

Figure 1 Index Data from 2012-2017

Source: Yahoo Finance

Table 1 Minimum Variance Hedge Ratio

Returns	SSE	HANG SENG
Spot volatility	23.51%	16.48%
Futures Volatility	26.49%	17.77%
Correlation	0.082	0.020
Minimum Variance Hedge Ratio	0.073	0.018

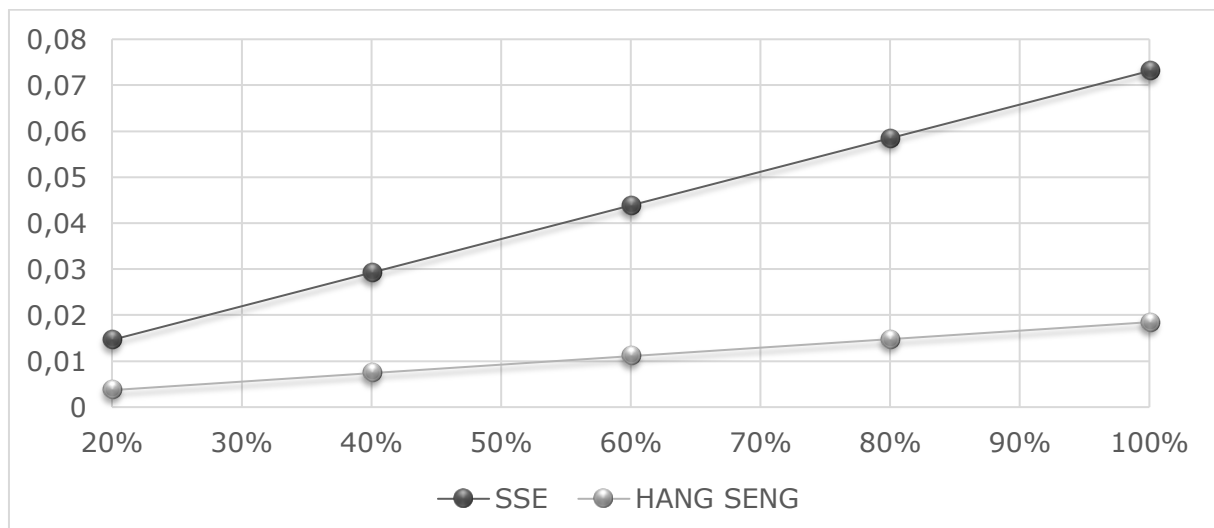
Source: Own calculation

The minimum variance hedge ratio is the product of the correlation coefficient between the changes in the spot and futures prices and the ratio of the standard deviation of the changes in the spot price to the standard deviation of the futures prices. The size of the minimum variance hedge ratio increases with the spot-futures correlation. When the spot and futures are very highly correlated the minimum variance hedge ratios are very close to 1. Otherwise might opposite.

Table 2 Minimum Variance Partial Hedge Ratio

	100% (full hedge)	80%	60%	40%	20%
SSE	0.073	0.058	0.044	0.029	0.015
HANG SENG	0.018	0.015	0.011	0.007	0.004

Source: own calculation

Figure 2 Minimum Variance Partial Hedge Ratio

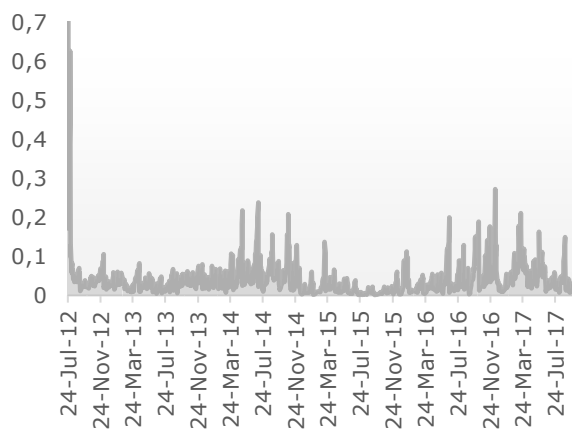
Source: own calculation

The result under the risk of 20%, the partial hedging with SSE is 0.015 and HSI is 0.004; under the risk of 40%, the partial hedging with SSE is 0.029 and HSI is 0.07; under the risk of 60%, the partial hedging with SSE is 0.044 and HSI is 0.011; under the risk of 80%, the partial hedging with SSE is 0.058 and HSI is 0.015; under the risk of 100% (full hedge), the hedging with SSE is 0.073 and HSI is 0.018. Though the increase of risk the partial hedging optimization is going up that is proof in the Figure 2.

The GARCH Minimum Variance Hedge

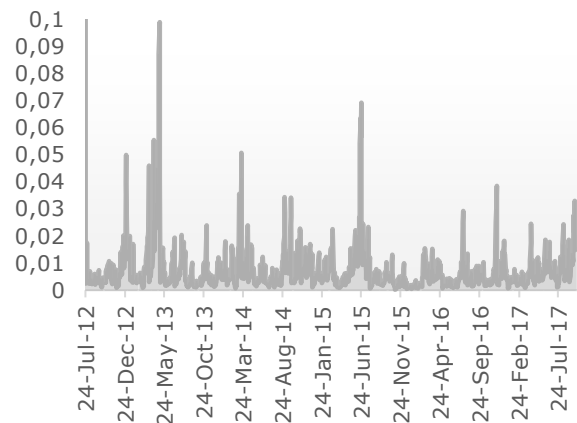
Illustrate that the case of SSE composite index and HANG SENG index apply GARCH minimum variance hedge which based on the equation (24) and (25). The time varying GARCH hedge are extremely variable. Following Figure 3 and Figure 4 present the GARCH minimum variance hedge ratio with full hedge risk and partial risk in SSE composite index (000001.SS) and HANG SENG index (^HSI).

Figure 3 (a) The GARCH Minimum Variance Hedge (SSE)



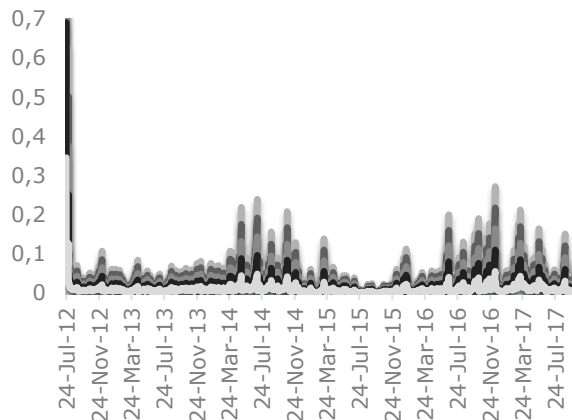
Source: own calculation

Figure 4 (a) The GARCH Minimum Variance Hedge (HSI)



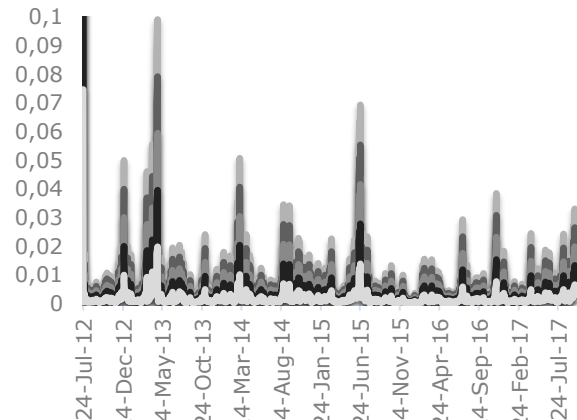
Source: own calculation

Figure 3 (b) The GARCH Minimum Variance Partial Hedge (SSE)



Source: own calculation

Figure 4 (b) The GARCH Minimum Variance Partial Hedge (HSI)



Source: own calculation

Time varying minimum variance hedge ratios estimated GARCH incorporate too much noise to be effective for hedging purposes and one is actually better off using OLS to estimate the minimum variance hedge ratio. The benefits of an active hedging strategy should be economically justifiable yet these models do not account for transactions costs, such as margins and commissions. When the costs of hedging are considered the case against time varying hedge ratios based on conditional covariances is strengthened even further. Result presents the GARCH hedge ratios sensitivity does not influence performance.

4 Conclusions

This paper analyzes the volatility model (GARCH model) to estimate minimum variance hedge ratio when the hedge is placed over a very short horizon (daily data) with SSE composite index (000001.SS) and HANG SENG index (^HSI). The forecast based on longer time series should be better. The characteristic property of the GARCH model is the slower reversion to the observed variance after greater shocks. In principle, the GARCH model is better compared with the EWMA model for short term forecasting. Hence, the following step of empirical study will the volatility model based EWMA minimum variance hedging.

References

- Alexander, C. (2008). *Market Risk Analysis Volume I: Quantitative Methods in Finance*. John Wiley & Sons.
- Alexander, C. (2008). *Market Risk Analysis Volume III: pricing, Hedging and Trading Financial Instruments*. John Wiley & Sons.
- Billio, M., Casarin, R., Osuntuyi, A. (2018). Markov switching GARCH models for Bayesian hedging on energy futures markets. *Energy Economics*, vol. 70, pp. 545-562.
- Chang, C., Gonzalez-Serrano, L., Jimenez-Martin, J. (2013). Currency hedging strategies using dynamic multivariate GARCH. *Mathematics and Computers in Simulation*, vol. 94(2013), pp. 164-182.
- Chung, S. (2009). Bivariate mixed normal GARCH models and out-of-sample hedge performances. *Finance Research Letters*, vol. 6, pp. 130-137.
- Focardi, M. S., Fabozzi, J. F. (2004). *The Mathematics of Financial Modeling & Investment Management*. Wiley.
- Frommel, M. (2010). Volatility regimes in central and eastern european countries' exchange rates. *Czech Journal of Economics and Finance*, vol. 1, pp. 2-21.
- Guo, H. (2012). Estimating Volatilities by the GARCH and the EWMA model of PetroChina and TCL in the stock exchange market of China. In: *6th Internatioal Scientific Conference Managing and Modeling of Financial Risks*. Ostrava: VSB – Technical University of Ostrava.
- Hull, C. J. (2006). *Option, Futures, and other Derivatives*. Prentice-Hall International.
- Lien, D. (2009). A note on the hedging effectiveness of GARCH models. *International Review of Economics & Finance*, vol. 18, pp. 110-112.
- Neftci, N, S. (2000). *An Introduction to the Mathematics of Financial Derivatives*. Academic press.
- Neftci, N, S. (2004). *Principles of financial engineering*. Elsevier academic press.
- Sengupta, N, A. (2005). *Pricing Derivatives: the Financial Concepts Underlying the Mathematics of Pricing Derivatives*. McGraw-Hall.
- Yan, Z., Li, S. (2018). Hedge ratio on Markov regime-switching diagonal Bekaert-Garch model. *Financial Research Letters*, vol. 24, pp. 49-55.
- Zmeskal, Z., Dluhosova, D., Tichy, T. (2004). *Financial Models*. 1st ed. Ostrava: VSB – Technical University of Ostrava.

Efficiency Hospitals in the Czech Republic: the Difference Between the Methods Used

Tatána Hajdíková¹, Kateřina Trubačová²

¹University of Economics, Prague
Faculty of Management, Department of Management
Jarosovska 1117/II, 37701, Jindřichuv Hradec, Czech Republic
E-mail: hajdikova@fm.vse.cz

²University of Economics, Prague
Faculty of Management, Department of Management
Jarosovska 1117/II, 37701, Jindřichuv Hradec, Czech Republic
E-mail: katerina.trubacova@seznam.cz

Abstract. *In the Czech Republic and other countries, the effective use of funds from public sources in the health care sector is a long-term research topic. There is pressure to increase the efficiency of healthcare providers. The paper deals with the analysis of the methods used to determine the effectiveness of hospitals in the Czech Republic. Many tools of financial analysis are used to assess financial health. In particular, various ratios, but only those situations that relate to them. However, there are a number of methods dealing with a more comprehensive view of the overall effectiveness of the subject. The aim of the paper is to discuss and assess whether the detection of financial health by various methods will contribute to the improvement of the financial situation of Czech hospitals. For assessing the benefits, account is taken of the financial position of the investigated hospitals found in research and research by other authors. Contributions will be used by hospitals from the calculation of the Ohlson O-Score Index, the Financial Strength Index, the Polish Collective Index by A. Bem and H'index in 2013-2016. The output of the contribution is the H'index financial health information compared to other indexes.*

Keywords: hospitals, performance, financial health

JEL Classification: I11, C6

1 Introduction

The health system is the most comprehensive component of the entire nonprofit sector amongst which the health services are generally the most commercial. More and more gainful activity of these services depends more on management than on volunteers (Worth, 2012).

The economic outturn of a healthcare facility may be positive or negative. Ideally, any economic subject should achieve long-term profitability. In healthcare, there may also be situations where it is not possible to say whether profit is a positive or negative aspect. General economic theories may be contrary to the criteria of success in health care (Pekova at al., 2012)

Since the end of the last century, a number of authors have been researching the economic effectiveness of hospitals (Sherman, 1984) (Zuckerman et al., 1994). In this millennium, researching the measurement of hospital efficiency and its determinants is a major concern of the healthcare economy (Jacobs, 2001) (Hofmarcher, 2002). To evaluate efficiency, quantitative economic analysis methods, including envelope analysis, are a useful tool. Their disadvantage is the difficulty of aggregating diverse data (Dlouhý, 2007). A summary of articles on efficiency assessments in health care is published by Hollingsworth (Hollingsworth, 2003).

2 Methodology and Data

For comparison, models that were created for and are applicable to hospitals were selected. The models differ from each other by the number of indicators and by their selection. Various limitations have been made in analyzing and evaluating results. Foreign models

appeal to the use of financial indicators that do not have the exact equivalents in the Czech Republic, such as the Cleverley Financial Strength Index and its "Days cash on hand" indicator. Czech hospitals often deal with loss and are perceived negatively in this respect. While calculating foreign indexes, Czech hospitals with negative economic outcomes are often ranked amongst the most stable and financially healthy.

Ohlson's O-Score is a multi-factor formula for the approaching bankruptcy's prediction. Ohlson, a big critic of Altman's Z-score, built his model on the data of 2000 bankrupt US companies. His model is considered to be more accurate than Altman's Z-score even due to the influence of internal and external factors (Ohlson, 1980).

The O-score formula (Ohlson, 1980):

$$O = -1,32 - 0,407 \log \left(\frac{TA_t}{GNP} \right) + 6,03 \frac{TL_t}{TA_t} - 1,43 \frac{WC_t}{TA_t} + 0,0757 \frac{CL_t}{CA_t} - 1,72X - 2,37 \frac{NI_t}{TA_t} - 1,83 \frac{FFO_t}{TL_t} + 0,285Y - 0,521 \frac{NI_t - NI_{t-1}}{|NI_t| + |NI_{t-1}|} \quad (1)$$

- TA total assets,
- GNP Gross National Product price index level,
- TL total liabilities,
- WC working capital,
- CL current liabilities,
- CA current assets,
- X=1 if TL > TA, 0 otherwise,
- NI net income,
- FFO funds from operations,
- Y=1 if a net loss for the last two years, 0 otherwise

The Financial Strength Index (FSI) was designed by William Cleverley specifically for American hospitals. This prevents problems arising from the use of bankruptcy and creditworthiness models and indexes designed for manufacturing companies. In his research, Cleverley dealt generally with health care systems. FSI is a composition of four dimensions: profitability, liquidity, financial leverage and age of physical equipment (Cleverley, 2002).

Basic FSI formula (Cleverley, 2002):

$$FSI = \left(\frac{total\ margin - 4,0}{4,0} \right) + \left(\frac{days\ cash\ on\ hand - 50}{50} \right) + \left(\frac{50 - debt\ financing\ \%}{50,0} \right) + \left(\frac{9,0 - average\ age\ of\ plant}{9,0} \right) \quad (2)$$

Polish indicators by Agnieszka Bem et al have been designed and tested to assess the financial health of Central European hospitals. The synthetic pointer is constructed using a gradient method. In Table 1 the indicators are divided into 4 categories - profitability, liquidity, debt and efficiency (Bem et al, 2015).

Table 1 Selected Financial Indicators

Label	Formula	Group
OPM	EBIT/Sales	profitability
CR	Current Assets/Current liabilities	liquidity
D%	Total debt/Total Assets	debt
CF/Debt	(Net profit + Depreciation) / Total debt	debt
TAT	Sales/Total Assets	efficiency
CES	Employee benefit expense/Sales	efficiency
ROCF	(Net profit + Depreciation) / Total Assets	profitability

Source: own edit (Bem et al, 2015)

Czech H'index is still the youngest model compiled through logistic regression on the data of Czech hospitals. It was built on the basis of extensive analysis of existing indexes and indicators (Hajdíková, 2016).

Basic H'index formula (Hajdíková, 2016):

$$H'index = 0,8277 + 80,8714U1 + 9,5314U2 + 1,7580U3 - 10,8281U4 \quad (3)$$

- U1 = EBIT/operating income
- U2 = Net profit + depreciation/total debt
- U3 = Operating income/total assets
- U4 = Cost of employee benefits/operating income

There are weighing coefficients in front of individual indicators (U_i). The constant in the formula is 0.8277, which increases the sum of the weighted values of the indicators. The basis for the goal of this paper is to select a correct research sample. Between 2013 and 2016 there were from 188 to 189 hospitals registered in the Czech Republic (ÚZIS, 2018). Secondary data from publicly available sources and the websites of individual hospitals were used in the research. The data from the website has coincided and can be considered as correct. Despite the legal obligation, some business entities do not publish their financial statements, which is also the case of some hospitals. The sample of hospitals that published and were included in the research sample is shown in Table 2.

Table 2 Number of Hospitals for the Research sample

Year	Number of hospitals
2013	99
2014	98
2015	85
2016	84

Source: ÚZIS (ÚZIS, 2018)

This research sample was selected using the cluster analysis. The clusters created contain units that are similar. Individual clusters vary considerably between each other. The final sample of examined hospitals is 84. The published evaluation applies the benchmarking method to the top 10 hospitals.

3 Results and Discussion

When calculating the O-score, a problem arises when an indicator within the equation is equal to zero. Ohlson pronounced the conclusion where the boundary value is 0,5. Values higher than 0,5 indicate the financial distress and, on the contrary, lower than 0,5 the financial health. Table 3 presents hospitals that can be considered financially sound and stable. Hospitals with financial loss have never been among the top 10 best-rated hospitals.

Table 3 Comparison of the Best Hospitals in the Czech Republic by O-score in 2013-2016

Hospital	Year			
	2013	2014	2015	2016
Centrum léčby pohyb. aparátu, s. r. o.	-9,43011	0	-5,51343	-6,54636
RHG spol. s r. o.	-7,82853	-6,38471	-8,64625	0
Poličská nemocnice, s. r. o.	-6,47412	-6,28977	-6,23757	-6,22558
Sdružené zdravot. zařízení Krnov, p. o.	-4,17787	-5,25399	-4,74197	-4,08734
Fakultní nemocnice Hradec Králové	-4,17593	0	-4,18853	-4,09987
Nemocnice Vyškov, p. o.	0	-5,11317	-4,56641	-5,23112
Nemocnice Ivančice, p. o.	0	-4,91298	-4,67252	-4,78224

Source: own research

Cleverley's Financial Strength Index considers indicators that are barely used in the Czech Republic for the assessment of financial health. The calculation of the index itself was seamless. Cleverley divides hospitals into three categories. The FSI ranging from -2,0 to 2,0 indicates that the hospital is financially unhealthy; values from 2,0 to 3,0 refer to hospitals with average financial health. The FSI with values greater than 3,0 refers to hospitals with excellent financial health. The results of the calculations were extremely high, which may be either due to a partial modification of the index indicators or due to the FSI not being suitable for assessing the financial health of Czech hospitals. It's also the only index considering different indicators and variables, so it tends to be more inappropriate than to misconduct. Table 4 shows the top 10 hospitals that have occupied the position for at least three of the four monitored years.

Table 4 Comparison of the Best Hospitals in the Czech Republic by FSI in 2013-2016

Hospital	Year			
	2013	2014	2015	2016
Nemocnice Žatec, o. p. s.	5229,64	48061,07	6018,765	5956,26
Středomoravská nemocniční, a. s.	4571,937	5604,65	5055,669	5323,665
Dopravní zdravotnictví, a. s.	4281,706	5274,472	4095,724	0
Oblastní nemocnice Kolín, a. s.	3928,919	0	5687,004	4987,923
Poliklinika Prosek, a. s.	3629,001	0	3772,078	3645,239
Nem. s poliklinikou Karviná – Ráj, p. o.	2722,068	804613,2	1798924	0
Sdružené zdravot. zařízení Krnov, p. o.	2584,261	395149,5	139047	138897
Nemocnice Ivančice, p. o.	0	632003,7	707935,1	686234,3
Masaryk. městská nem. v Jilemnici, p. o.	0	724249,4	867014,2	0
Nemocnice Vyškov, p. o.	0	227650,2	1174428	346787,76

Source: own research

The calculation of Polish financial health indicators in Table 5 differs slightly from previous calculations. There is no formula or equation that would be definitive and authoritative for application in assessing the financial health of hospitals. This is the calculation of seven indicators, which are further independently evaluated. After calculating the indicators, the OPM (EBIT / Sales) variable was chosen, according to which the hospitals were ranked downwards from best to worst. Subsequent analysis has shown that, according to the OPM, the financial condition of the hospitals is assessed as "bad". In addition, it is appropriate to state that all hospitals of the research sample were evaluated negatively. The use of these indicators is not appropriate for a person who did not participate in the research. It serves as a different view on the subject and the impetus for a deeper analysis and an subsequent research.

Table 5 Comparison of Hospitals Using the Polish Index (OPM) in 2013-2016

Hospital	2013	2014	2015	2016
Centrum léčby pohyb. aparátu, s. r. o.	0,264843	0	0,0888950,345566	
RHG spol. S r. o.	0,216902	0,234035	0,245868	0
Mediterra Sedlčany, s. r. o.	0,149217	0,061046		00,098457
Nemocnice Podlesí, a. s.	0,14225	0,147729	0,0841950,108834	
Nemocnice sv. Zdislavy, a. s.	0,141749	0,051459	0,053516	0
Poličská nemocnice, s. r. o.	0,099874	0,14088	0,1230990,134766	
Hornická nem. s polik., spol. s r. o.	0,091311	0,083072		00,089866
SANATORIUM Helios, s. r. o.	0	0,146503	0,1902070,173322	
Nemocnice Valtice, s. r. o.	0	0,108945	0,0807470,090944	
Nemocnice Český Těšín, a. s.	0	0,069887	0,0787030,061233	

Source: own research

H'index, as the only one outlined in Table 6, was designed to assess the financial health of Czech hospitals. It responds to the trend when hospitals have a need to compare their achievements with competition, while the competitive fight is quite large. H'index operates with Czech data and considers indicators that are commonly used in the Czech Republic to assess financial health.

Table 6 Comparison of the Best hHospitals in the Czech Republic Using the H'index

Hospital	Year			
	2013	2014	2015	2016
Centrum léčby pohyb. aparátu, s. r. o.	44,02907	0	17,34271	22,43736
RHG spol. s r. o.	31,7627	28,53735	38,99768	0
Nemocnice Podlesí, a. s.	19,28659	18,31247	10,8022	17,8765
Hornická nem. s poliklinikou, spol. s r. o.	16,94159	15,15379	0	16,87655
Poličská nemocnice, s. r. o.	14,0115	18,13052	16,7603	16,7822
Nemocnice Valtice, s. r. o.	12,35539	11,01899	9,058287	11,00878
SANATORIUM Helios, s. r. o.	0	15,03902	22,19845	22,26766

Source: own research

To make it more accurate to determine whether the researched indexes are suitable for assessing the financial health of Czech hospitals, it is necessary to compare them with real results or with a similar research. Because there is no similar research, where these indexes would be tested on Czech hospital data, a benchmarking method was used. It is based on HCI's list of success rate of hospitals (Health Care Institut, 2018). The list is made on the data of Czech hospitals. The results of H'index in this paper are the same as those in the list, or only slightly different depending on the origin and method of collection of the researched data. Another comparison is devoted to the FSI index. FSI values are completely different in size, often in hundreds of thousands. The FSI results can hardly be grasped and evaluated. The listed index contained the most unknown indicators and its modification could distort the results. The formula of the Ohlson's index has overturning results. Negative values mean financially sound hospitals and positive values mean hospitals with financial problems. It was not possible to compare numerical values, so hospitals were compared only in terms of whether they were placed in the top 10 list. Polish indicators are deliberately omitted because of the lack of interpretation. The base for the evaluation was probably not chosen appropriately, therefore it is not possible to evaluate the suitability of the indicators.

4 Conclusions

Healthcare is currently a widely discussed topic. Even in this sector, the trend of the present time - the comparison with the competition - is interfering. Indexes help the economic subjects with fast comparison between each other. It is related to the need for leadership, being the best in the group. A key compromise in the management of hospitals and other healthcare facilities is to ensure prosperity and fulfillment of the mission in the care of the health and well-being of the population. The main benefit of aggregate financial health assessment indexes is their easy and quick application. The result is one value that has a clear message. The resulting value is a determinant for the management and may be followed by a more thorough financial analysis. It is advisable to combine both methods, not relying on just one. In the Czech Republic there are widely used other methods of financial analysis and also indexes that are not suitable for Czech hospitals. Indexes built primarily for hospitals were introduced in this paper. Also, the capability of the new H'index was introduced. From the selected foreign indexes, the O-score index for the Czech Republic has the greatest information. Of all the indexes examined, the Cleverley FSI index is the least appropriate.

Acknowledgments

Information on acknowledgments and financial support are posted here.

References

- Bem, A., Siedlecki, R., Predkiewicz, P., Ucieklak-Jez, P., Hajdikova, T. (2015). Hospital's financial health assessment. Gradient method's application. *Proceedings Enterprise and the Competitive Environment*, pp. 76-86.
- Cleverley, W. O. (2002). Who is responsible for business failures?. *Healthcare Financial Management*, vol. 56(10), pp. 46-50.
- Dlouhy, M., Jablonsky, J., Novosadova, I. (2007). Use of Data Envelopment Analysis for Efficiency Evaluation of Czech Hospitals. *Politická ekonomie*, vol. 54, pp. 60-71.
- Hajdikova, T. (2016). Návrh indexu predikce finanční výkonnosti pro podporu rozhodování managementu nemocnic.
- Healthcare Institute (2018). Retrieved from: <http://www.hc-institute.org/cz/>.
- Hofmarcher, M. M., Peterson, I., Riedel, M. (2002). Measuring Hospital Efficiency in Austria - A DEA Approach. *Health Care Management Science*, vol. 5, pp. 7-14.
- Hollingsworth, B. (2003). Non-Parametric and Parametric Applications Measuring Efficiency in Health Care. *Health Care Management Science*, vol. 6, pp. 203-218.
- Jacobs, R. (2001). Alternative Methods to Examine Hospital Efficiency: Data Envelopment Analysis and Stochastic Frontier Analysis. *Health Care Management Science*, vol. 4, pp. 103-116.
- Ohlson, J. A. (1980). Financial Ratios and the Probabilistic Prediction of Bankruptcy. *Journal of Accounting Research*, vol. 18(1), pp. 109-131.
- Pekova, J., Pilny, J., Jetmar, M. (2012). *Veřejný sektor – řízení a financování*. Praha: Wolters Kluwer Česká republika.
- Sherman, D. H. (1984). Hospital Efficiency Measurement and Evaluation. Empirical Test of a New Technique. *Medical Care*, vol. 22, pp. 922-938.
- ÚZIS (2018). *Institute of Health Information and Statistics of the Czech Republic*. Retrieved from: <http://www.uzis.cz/>.
- Worth, M. J. (2012). *Nonprofit management: principles and practice*, 2nd ed. Los Angeles: Sage.
- Zuckerman, S., Hadley, J., Iezzoni, L. (1994). Measuring Hospital Efficiency with Frontier Cost Functions. *Journal of Health Economics*, vol. 13, pp. 255-280.

Level of Industry Automation 4.0 in the Czech Republic and Impact on Unemployment

Martina Hedvičáková, Martin Král

¹ University of Hradec Králové
Faculty of Informatics and Management, Department of Economics
Rokitanského 62, 500 03 Hradec Králové, Czech Republic
E-mail: martina.hedvicakova@uhk.cz

² University of Hradec Králové
Faculty of Informatics and Management, Department of Economics
Rokitanského 62, 500 03 Hradec Králové, Czech Republic
E-mail: martin.kral.2@uhk.cz

Abstract: *The Czech Republic has the lowest unemployment rate throughout the European Union. According to Eurostat and the Czech Statistical Office, in March 2018, the unemployment rate in the Czech Republic reached 2.2%. Such a low unemployment rate causes an excess of demand over supply. Companies are looking for ways of meeting the demand of their customers. One of the possibilities is technological progress. For this reason, both the Czech Republic as well as the European Union are promoting the Industry 4.0 initiative and at the present time also the Work 4.0. The aim of the paper is to analyse the impact of Industry 4.0 and Work 4.0 on the labour market. The paper contains an analysis of the share of unemployed people in individual regions and the development of wages. The manufacturing industry is one of the key sectors of the Czech economy. The following hypotheses are tested: The impact of Industry 4.0 is markedly different in the Czech Republic regions and second As a result of the enforcement of Industry 4.0 (production automation), unemployment varies across regions.*

Keywords: *Region, Industry 4.0, wages, cluster analysis, unemployment*

JEL codes: *J21, E2, L16, O33*

1 Introduction

Originally initiated in Germany, Industry 4.0, “the fourth industrial revolution”, has attracted much attention in recent literatures. It is closely related with the Internet of Things (IoT), Cyber Physical System (CPS), information and communications technology (ICT), Enterprise Architecture (EA), and Enterprise Integration (EI). (Lu, 2017). Industry 4.0 is defined as “the integration of complex physical machinery and devices with networked sensors and software, used to predict, control and plan for better business and societal outcomes” (Industrial Internet Consortium, 2014) or “a new level of value chain organization and management across the lifecycle of products” (Kagermann H, Helbig J., 2013). or “a collective term for technologies and concepts of value chain organization” (Hermann, Pentek, 2015). Thus, the concept of Industry 4.0 can be perceived as a strategy for being competitive in the future. It is focused on the optimization of value chains due to autonomously controlled and dynamic production (Acatech, 2013, 2017, Mrugalska, Wyrwicka, 2017, Hedvicakova, 2018, Soukal, et al. 2012)

The impact of Industry 4.0 on the labour market will be very complex and also contradictory. So far their research in the Czech Republic hasn't been given the right attention. One of the exceptions is Chmelař (2015) from the Strategy and Trends Department of the Czech Republic Government Office, who prepared a study: The Impact of Digitisation on the Labour Market in the Czech Republic and the EU. The paper deals with the effects of narrow digitalisation and attempts to estimate employment threats in professional groups based on coefficients that are taken from a US labour market study. Calculations made so far on the disappearance and creation of jobs are different in relation to the methodology used. Specifically for the Czech Republic, it's estimated that 10% of jobs are seriously threatened by automation over the next 20 years, and 35% of jobs will experience significant changes in the activities carried out. If this estimate, published in

the OECD study (Employment Outlook 2016), counts on the number of people employed in 2015, about 408,000 jobs will be significantly threatened, and 1.4 million jobs will experience major changes. (Work Initiative 4.0). (Hedvicakova, 2018a)

2 Methodology and Data

Mainly secondary sources were used when processing this paper. Secondary sources include specialised literature, gathering information from professional press, websites, databases, discussions or previous attendance on specialised seminars or conferences within the chosen subject area. (Hedvičáková, Svobodová, 2017) Key information was obtained from the official websites of the Czech Statistical Office, the Ministry of Industry and Trade, OECD, Eurostat, as well as from specialised servers and portals such as iHned.cz, etc. Not enough attention has been devoted to Labour market research in connection with Industry 4.0 yet. This topic was dealt with by Chmelař, 2015 The Impacts of Globalisation on the Labour Market in the Czech Republic and the EU and the Ministry of Labour and Social Affairs 2015 by anticipating the qualification needs. The Ministry of Labour and Social Affairs has elaborated the Work 4.0 study that this paper is based on. (Hedvičáková, Svobodová, 2016, 2017, Svobodová, Hedvičáková, 2017,)

The paper uses the general unemployment rate according to the CSO's calculation methodology, where the unemployment rate is calculated within Selected Survey of Labour Force (SSLF, based on the recommendations of Eurostat, ILO International Labour Organisation) as the so-called general unemployment rate. Furthermore, the values of the share of unemployed people. (Hedvičáková, 2018)

The aim of this paper is to analyse the possible impacts of the Industry 4.0 Initiative, which can be expected on the labour market in the Czech Republic with a focus on individual regions.

The following hypotheses are tested:

H1: The impact of Industry 4.0 is markedly different in the Czech Republic regions.

H2: As a result of the enforcement of Industry 4.0 (production automation), unemployment varies across regions.

The secondary data of the Czech Statistical Office were used to test the hypotheses mentioned above. The data were both aggregate for the whole of the Czech Republic, as well as individual data only for individual regions including the capital city of Prague. Some of the most significant characteristics were the number of industrial companies with 100 or more employees, the sales of industrial goods and services, the average gross monthly wage in industry, GDP, GDP per capita, emissions data (solids, sulfur dioxide, etc.) and gross fixed capital increase (GFC).

Based on the data for the period 2000 to 2016, incremental indices of individual indicators were calculated. Further, based on data from 2016, cluster analysis was performed. A hierarchical method of clustering with the Euclidean distances of the centroid of each cluster was used. Its aim was to merge regions with similar characteristics to make it easier to determine whether Industry 4.0, by replacing labor with capital, has the potential to increase unemployment in individual regions. In the last phase, Pearson's correlation coefficients were calculated for the number of unemployed registered by the Labor Offices and the selected above-mentioned characteristics.

3 Results and Discussion

Share of unemployed people in individual regions

According to the Czech Statistical Office, the share of unemployed people was 5.19% in 2016. In the following year, the share of unemployed people in the Czech Republic fell to 3.77%, which is lower than the natural rate of unemployment. For this reason, in 2017 the labour market experienced excess of demand over the supply. Companies complained that

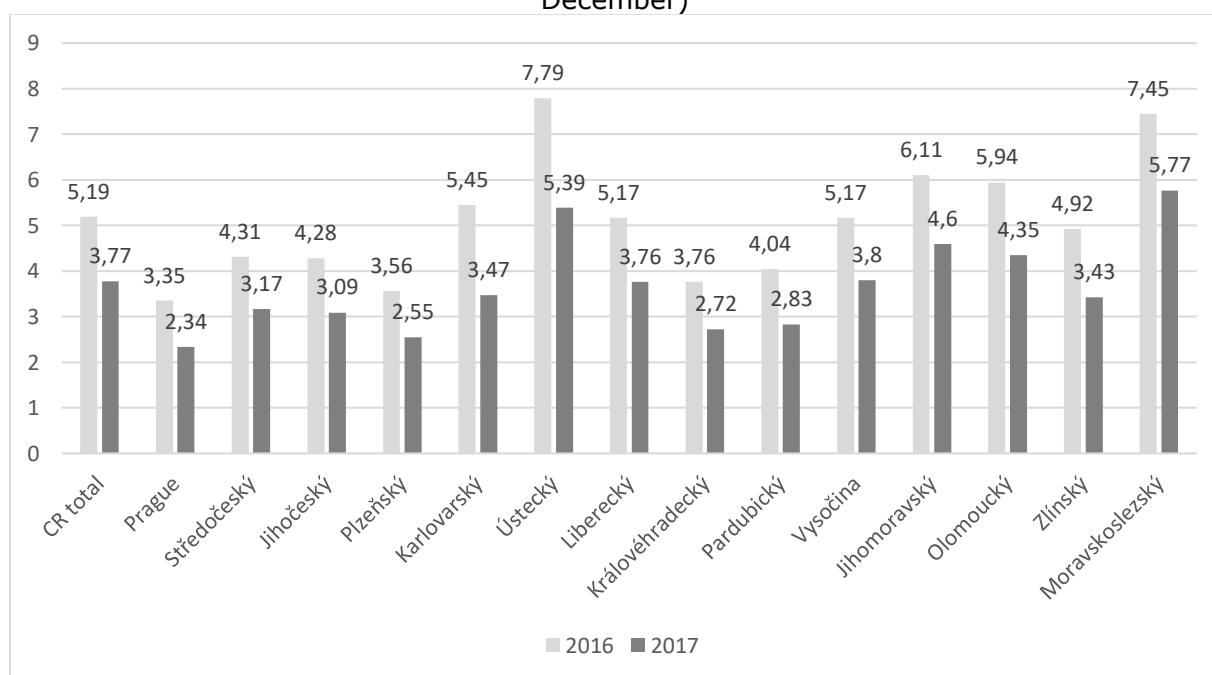
they couldn't find a sufficiently skilled workforce at a given wage rate. In all analysed regions, the proportion of unemployed people decreased in 2017.

The highest share of unemployed people was in the Ústí nad Labem Region, where it was 7.79% in 2016, it then fell to 5.39% in 2017. The second highest share of unemployed people in the Moravian-Silesian Region was 7.45% in 2016 and in the following year it dropped to only 5.77%. In 2017 this region has the highest share of unemployed people within the Czech Republic.

The lowest share of unemployed people was in the Capital City of Prague where the share of unemployed people reached 3.35% in 2016 and fell to 2.34% in the following year. Three percent of the share of unemployed people in 2017 also wasn't exceeded by the Pilsen, Hradec Králové and Pardubice regions. 3.09% was the share of unemployed people in the South Bohemian Region. The share of unemployed in the Central Bohemia Region was 3.17%.

The Figure 1 below shows that the share of unemployed people was below the natural rate of unemployment in most regions in 2017 and that the firms didn't have sufficient qualified work. At a time of economic growth, capital substitution is appropriate and the share of investment is growing in the Czech Republic. (Hedvicakova, 2018a)

Figure 1 Share of Unemployed People in the Czech Republic by Region (as on 31 December)



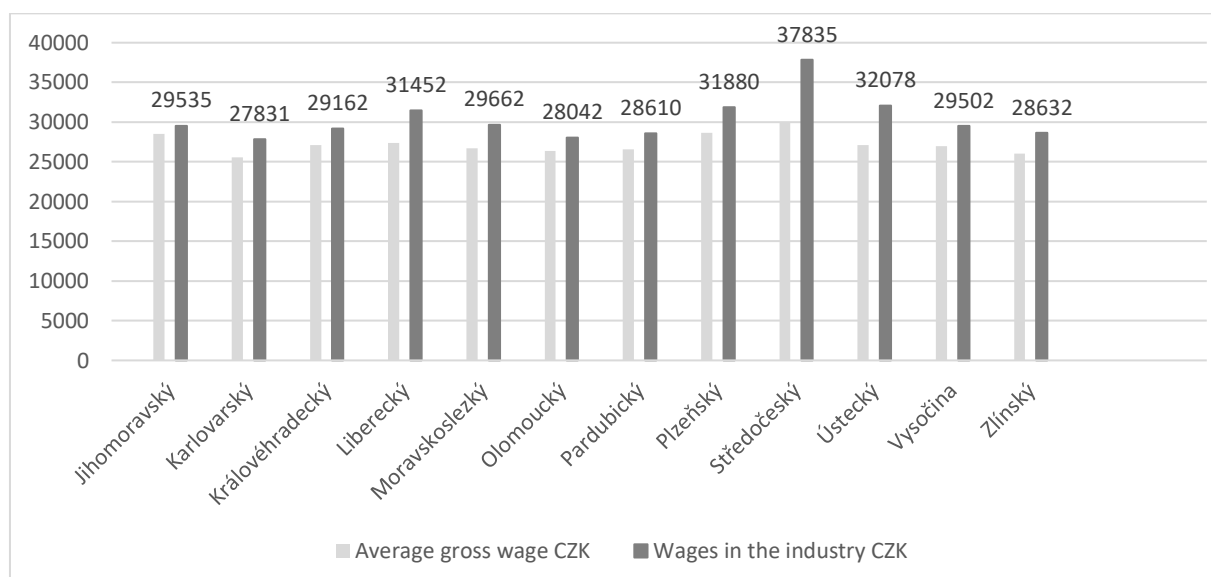
Source: Czech Statistical Office (2018), (Hedvicakova, 2018a)

Wage developments in the manufacturing industry

The manufacturing industry is significantly involved in GDP growth in the Czech Republic. A significant percentage of workers are also employed in the manufacturing industry. For this reason, manufacturing industry wages were analysed. (Hedvicakova, 2018a)

The development of personnel costs in the manufacturing industry over the period 2008 to 2016 corresponds to the development of sales with year-on-year relative changes being mostly lower. (See figure 2.) The proportion of individual divisions in personal costs varies between the share of sales and the share of value added. (Ministry of Industry and Trade, 2016a).

Figure 2 Wages in Industry in CZK in 2017



Source: Czech Statistical Office (2017), own processing

Main Region characteristics

The number of enterprises active in the industry differs significantly in the Czech Republic. The highest concentration of these companies (with 100+ employees) is according to the CZSO in Prague and the Central Bohemian Region, their total number in the last years was around 450, which represents approximately 20% of all such enterprises in the Czech Republic. On the contrary, the smallest number of industrial enterprises is in West Bohemia - the Karlovarský Region, but this may be due to some extent, in addition to its location, by its size. The number of companies is also related to total sales in the industry, which in the Central Bohemia reached almost CZK 1 billion in 2016, ie almost 30% of the industry's sales in the whole Czech Republic. This fact was also reflected in the average gross monthly wage in industry, as in 2016 it exceeded CZK 30 thousand only in Prague (CZK 32,295) and Central Bohemia (CZK 31,507), whereas the average wage in the industry for the whole of the republic was only 27,676 CZK.

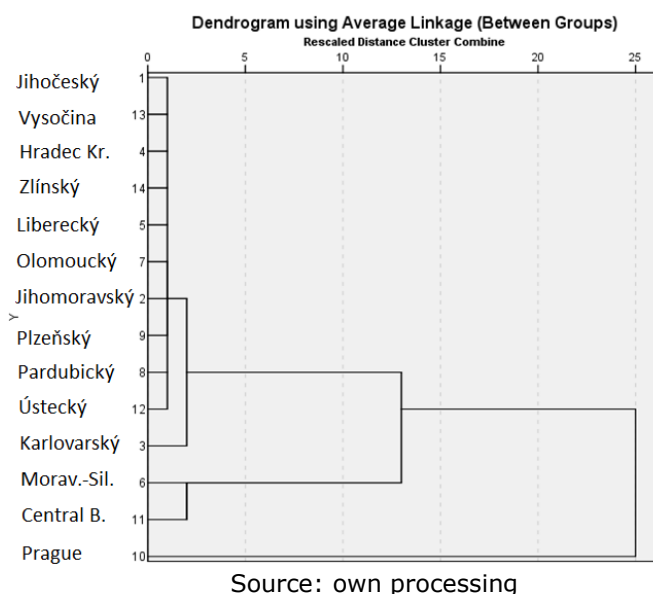
Other significant differences in connection with Industry 4.0 have also occurred in gross fixed capital formation (acquisitions and disposals of tangible and intangible fixed assets that have the character of an investment and the cost of improvements in capital goods) in the past years where was the trend of accumulation to the already industrially developed areas. From 2010 to 2015, gross fixed capital growth increased by 20% in only five of the 14 regions - Prague, Central Bohemia, Zlínský region, Moravian-Silesian region and Královéhradecký region, where it was even 36.7%, i.e. two and a half times the average in the Czech Republic, and due to the labor shortage in the labor market, it can be expected to increase further.

It follows from the above that the impact of Industry 4.0 is not the same in the whole Czech Republic. While in the industrially "developed" regions the growth rate of gross fixed capital is rising in the last years, in others it is slowing down (e.g. the Ústecký region or Karlovarský region).

In order to obtain more specific and aggregate characteristics common to each region, a cluster analysis was performed. Its aim was to include all regions and the Capital City of Prague in certain clusters with similar characteristics, which would allow for a more comprehensive estimation of the impacts of the development of the Industry of 4.0 regions. At the same time, it will be possible to determine which regions and for what reason they will be positively affected by Industry 4.0 and which regions are among the most vulnerable.

For the purpose of this cluster analysis, variables that affect industry and innovation are affected, i.e. the number of enterprises, industrial sales, average gross monthly wages in the industry, GDP per capita, emissions data (solids, sulfur dioxide, nitrogen oxide, carbon monoxide) and gross fixed capital formation per capita. A hierarchical method of clustering was used with the Euclidean distances of each centroid (see Fig. 3).

Figure 3 Dendrogram – Cluster Analysis



Three clusters were created. The first contains only Prague, the second cluster consists of the Central Bohemian region and the Moravian-Silesian Region, and the third cluster consists of the other regions. The strongest predictor for the inclusion of the region in the respective cluster was GDP per capita and gross fixed capital formation per capita, while sales, wages and emissions data were rather complementary. Table 1 gives the following characteristics:

Table 1 Final Cluster Centers

	Cluster 1 - Prague	Cluster 2 – Central Bohemia region, Moravian- Silesian region	Cluster 3 – Other regions
Number of industry companies (100+ employees)	228.00	229.00	150.00
Industry - turnover	304,183.85	606,456.84	173,917.04
Industry - wages	32,295.00	29,487.00	24,104.00
Unemployed	30,179.00	51,501.00	22,563.00
GDP per capita	937,542.23	399,812.66	384,340.99
emissions - solids	1.79	0.76	0.52
emissions - solids	0.50	2.55	1.54
emissions - sulfur dioxide	11.83	3.20	1.89
emissions - nitrogen oxide	22.10	17.80	4.38
emissions - carbon monoxide	271,213.55	103,834.60	88,420.02
GFCF per capita	228.00	229.00	150.00

Source: Czech statistical office (2018a), own processing

A correlation analysis was carried out on selected data for the period 2000 to 2016. Its aim was to find out a relationship with unemployment to other characteristics in individual regions - clusters. The results are shown in the following table 2.

Table 2 Pearson Correlations Between Unemployment and Other Characteristics

	Number of industry companies (100+ employees)	Industry - turnover	Industry - wages	GDP per capita	GFCF per capita
Other regions	0.584	0.514	0.116	-0.094	-0.026
Central Bohemia region + Moravian- Silesian region	0.579	0.511	0.107	-0.102	-0.032
Prague	0.575	0.526	0.117	-0.092	-0.036

Source: Czech statistical office (2018a), own processing

Table 2 shows that for all three clusters there are equally directed relationships with respect to each characteristic. The strongest positive relationship with unemployment in the 2000 - 2016 period was demonstrated in the number of industrial enterprises and industrial sales. With average wages in the industry, correlations are very low, with negative ratios of GDP per capita negative (the higher the GDP, the lower the unemployment rate). Somewhat strange, however, is the almost zero relationship of unemployment with the increase in gross fixed capital per capita. However, this is due to the labor shortage in the labor market - despite the significant replacement of labor by capital, unemployment is not increasing in any cluster.

4 Conclusions

It follows from the above that the industrial revolution will have negative impacts on unemployment. But it will be a longer time horizon and if there is an education reform, the labour market will be prepared for these changes. The Czech Republic has one of the lowest unemployment rates across the EU and companies currently have the problem of finding a skilled workforce. The second aspect is average wages, which are among the lowest in the EU. This prevents the rapid take-up of modern technologies. The economic cycle, when economists are already discussing the "overheated economy" (e.g. the Governor of the Czech National Bank, Jiří Rusnok, 2018) and the political determination, to bring wages in the Czech Republic closer to the European Union's average, will be affected by the onset of modern technologies and massive purchasing of technologies. Because the Czech Republic is a small open economy, a big impact will be on the rapid rise of Industry 4.0 as well as the inflow of foreign investment. (Hedvicakova, 2018a)

The paper was devoted to two parts and an analysis was carried out in order to determine whether the industry is significantly different in individual regions of the Czech Republic and whether the unemployment in the regions differs due to the enforcement of Industry 4.0 (production automation). From the point of view of industrial production data, the regions of the Czech Republic differ greatly. While the center of the Czech Republic and the Moravian-Silesian region are among the areas where industry plays a very important role, Western and Northwest Bohemia in the current period are experiencing a decline in their industrial significance. This is reflected not only in rising wages but, in particular, in the differential increase in gross fixed capital, which is concentrated in more developed areas. By automating industrial production there is and is likely to be a further increase in disparities between richer regions (especially Prague and Central Bohemia) and poorer regions (northwestern Bohemia). These differences, however, do not show up in the current economic growth in the growth of unemployment, and from the economic point of view it can be said that the Czech Republic is in a unique period in which it can exploit the potential of Industry 4.0.

Acknowledgments

The paper was elaborated in the framework of the specific research "Evaluation of investments within the Industry 4.0 concept" and the internal grant project "Support of pedagogical work, technical equipment and communication with experts" at the University of Hradec Králové, Faculty of Informatics and Management

References

- Acatech (2013). *Umsetzungsempfehlungen für das zukunftsprojekt industrie 4.0 – abschlussbericht des arbeitskreises industrie 4.0*. Retrieved from: https://www.bmbf.de/files/Umsetzungsempfehlungen_Industrie4_0.pdf.
- Acatech (2017). *Industrie 4.0 – White paper rFuE-Themen. Acatech-Plattform Industrie 4.0*. Retrieved from: http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Website/Acatech/root/de/Aktuelles___Presse/Presseinfos___News/ab_2014/Whitepaper_Industrie_4.0.pdf.
- Acemoglu, D. (2010). Labour and capital-augmenting technical change. *Journal of the european economic association*, vol. 1(1), pp. 1–37. DOI: 10.1162/154247603322256756.
- Antony, J. (2009). Capital/labour substitution, capital deepening, and fdi. *Journal of macroeconomics*, vol. 31(4), pp. 699–707. Doi 10.1016/j.jmacro.2008.12.004.
- Český statistický úřad (2018). *Podíl nezaměstnaných osob v ČR a krajích, 2005-2017*. Retrieved from: https://www.czso.cz/csu/czso/cr_od_roku_1989_podil_nezamestnanych
- Český statistický úřad (2017). *Regionální statistiky*. Retrieved from: https://www.czso.cz/csu/czso/regiony_mesta_obce_souhrn.
- Český statistický úřad (2017a). *Počet obyvatel v obcích - k 1.1.2017*. Retrieved from: <https://www.czso.cz/csu/czso/pocet-obyvatel-v-obcich-k-112017>.
- Český statistický úřad (2017b). *Ukazatele sociálního a hospodářského vývoje české republiky - 3. Čtvrtletí 2017*. Retrieved from: <https://www.czso.cz/csu/czso/ukazatele-socialniho-a-hospodarskeho-vyvoje-ceske-republiky-3-ctvrtleti-2017>
- Český statistický úřad (2018a). *Regionální časové řady*, Retrieved from: https://www.czso.cz/csu/czso/regionalni_casove_rady.
- Frey, c. B., Osborne, M. (2013). *The future of employment: how susceptible are jobs to computerisation?* Oxford: Oxford Martin School.
- Frey, c. B., Osborne, M. (2015). *Technology at work. The future of innovation and employment*. Retrieved from: https://www.oxfordmartin.ox.ac.uk/downloads/reports/Citi_GPS_Technology_Work.pdf.
- Hedvicakova, M., Svobodova, L. (2016). Unemployment in the European Union with the emphasis on the Visegrad Four. In: *Proceedings of the 28th international business information management association conference*. Spain, Sevilla, pp. 4217-4221, ISBN: 978-0-9860419-8-3.
- Hedvicakova, M. (2018). Unemployment and effects of the first work experience of university graduates on their idea of a job. *Applied Economics*, vol. 50(31), pp. 3357-3363. Doi: 10.1080/00036846.2017.1420895.
- Hedvicakova, M., Svobodová, L., (2017). The labour market of the Czech Republic in the context industry 4.0. In: *XX. Mezinárodní kolokvium o regionálních vědách kurdějov. Sborník příspěvků*. Brno: Masarykova univerzita, pp. 302–310, ISBN: 978-80-210-8586-2, doi 10.5817/cz.muni.p210-8587-2017-38.
- Hedvicakova, M. (2018a). Dopady iniciativy Průmyslu 4.0 na nezaměstnanost a vývoj mezd, XXI. In: *Mezinárodní kolokvium o regionálních vědách Kurdějov. Sborník příspěvků*. Brno: Masarykova univerzita, in press.

- Hermann, M., Pentek T. O. B. (2015). *Design principles for Industrie 4.0 scenarios: a literature review*. Retrieved from: http://www.snom.mb.tudortmund.de/cms/de/forschung/Arbeitsberichte/Design-Principles-for-Industrie-4_0-Scenarios.pdf.
- Chmelař, A. et al. (2015). *Dopady digitalizace na trh práce v ČR a EU*. Úřad vlády ČR. Praha.
- Danelová, M. (2018) Kvůli digitalizaci a robotizaci zanikne přes polovinu pracovních míst v Česku, tvrdí premiérův poradce Špidla. Retrieved from: <https://byznys.ihned.cz/c1-65772700-kvuli-digitalizaci-a-robotizaci-zanikne-pres-polovinu-pracovnich-mist-v-cesku-tvrdi-premieruv-poradce-spidla>.
- Industrial Internet Consortium (2014). *A global nonprofit partnership of industry, government and academia*. Retrieved from: <http://www.iiconsortium.org>.
- Kagermann, H., Lukas, W., Wahlster, W. (2011). *Industrie 4.0 - mit dem Internet der Dinge auf dem Weg zur 4. Industriellen Revolution*. Retrieved from: http://www.wolfgangwahlster.de/wordpress/wpcontent/uploads/Industrie_4_0_Mit_dem_Internet_der_Dinge_auf_dem_Weg_zur_vierten_industriellen_Revolution_2.pdf.
- Kagermann H., Helbig J. (2013). *Recommendations for implementing the strategic initiative INDUSTRIE 4.0*. Retrieved from: http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Website/Acatech/root/de/Material_fuer_Sonderseiten/Industrie_4.0/Final_report__Industrie_4.0_accessible.pdf
- Lu, Y. (2017). Industry 4.0: A survey on technologies, applications and open research issues. *Journal of Industrial Information Integration*, vol. 6, pp. 1-10. DOI: <https://doi.org/10.1016/j.jii.2017.04.005>.
- OECD employment outlook (2016). ISBN: 9789264258129. Retrieved from: http://dx.doi.org/10.1787/empl_outlook-2016-en.
- Průmysl 4.0 (2017). Retrieved from: <http://www.nuv.cz/eqf/iniciativy-prumysl-4-0-prace-4-0-a-vzdelavani-4-0>.
- Iniciativa práce 4.0 (2016). Retrieved from: https://portal.mpsv.cz/sz/politikazamest/prace_4_0/studie_iniciativa_prace_4.0.pdf.
- Ministerstvo průmyslu a obchodu (2016). *Průmysl 4.0 má v Česku své místo*. Retrieved from: <https://www.mpo.cz/cz/prumysl/zpracovatelsky-prumysl/prumysl-4-0-ma-v-cesku-sve-misto--176055/>.
- Ministerstvo průmyslu a obchodu (2016a). *Panorama zpracovatelského průmyslu ČR 2016*. Retrieved from: <https://www.mpo.cz/assets/cz/prumysl/zpracovatelsky-prumysl/panorama-zpracovatelskeho-prumyslu/2017/10/panorama-2016-cz.pdf>.
- Mrugalska, B., Wyrwicka, M. K. (2017). Towards Lean Production in Industry 4.0. *Procedia Engineering*, vol. 182, pp. 466-473. DOI: <https://doi.org/10.1016/j.proeng.2017.03.135>.
- Rusnok, J. (2018). *Česká ekonomika by si zasloužila vyšší potenciální růst*. Retrieved from: https://www.cnb.cz/cs/verejnost/pro_media/clanky_rozhovory/media_2018/cl_18_1803_18_rusnok_ovm.html.
- Soukal, I., Draessler, J. (2012). Consumer desired price modeling – case study on the RCBS market. *Procedia – social and behavioral sciences*, vol. 62, pp. 916-920. ISSN 1877-0428.
- Svobodová, L., Hedvicakova, M. (2017). Technological readiness of the Czech Republic and the use of technology. In: *Information Systems – 14th European, Mediterranean, and middle eastern conference, EMCIS 2017. Coimbra, Portugal: September 7-8, 2017, proceedings. Lecture notes in business information processing*. Springer International Publishing, vol. 299, pp. 670-678. ISBN 978-3-319-65929-9.

Industry 4.0 Aimed at Accounting System

Irena Honková

University of Pardubice
Faculty of Economics and Administration, Institute of Business Economics and Management
Studentská 95, 532 10 Pardubice, Czech Republic
E-mail: irena.honkova@upce.cz

Abstract: Industry 4.0 means a current trend of digitalisation and related automation of production and changes at the labour market brought together with the Industry 4.0. More and more internal as well as external integration occurs, more and more data is collected for analysis and decision making, top management requires access to data in real time, we transfer to unified protocols, the quantity of wireless communication devices grows and thus the level of isolation of company systems is considerably reduced. This text discusses the digitisation within the accounting sphere. With its case study it shows how the requirements on presentation and information sharing of accounting and taxation sphere change: options to send tax documents in electronic form, links to Internet banking, XML communication, Internet shops or accounting in mobile phones. This text aims to provide the view not only on the accounting software but also on work of book-keepers. Thus the text presents the view on the whole accounting system within the environment of Industry 4.0. The final part of this text discusses the readiness of companies to the Industry 4.0.

Keywords: Industry 4.0

JEL codes: M41

1 Introduction

The scientific and technical development can be divided in several revolutions (Tab. 1). First three of them resulted from the technical revolution and the revolution in electronics and mechanics. (Halenár, 2016).

The first industry revolution was based on the production mechanisation with the use of water and vapour energy. The second one included the electricity in the industrial production, the third one than has brought the automation using the electronics and information and communication technologies. (Vacek, 2016)

The current stage of the industry development can be described as the revolution of informatics and communication. This causes the high level of globalisation and foundation of companies of which the existence is based on the communication (Halenár, 2016). This trend is called as the Industry 4.0.

The Industry 4.0 related to the previous wave but there is a convergence of technologies that tears down wall among physical, digital and biological worlds. The convergence technologies usually include information and communication technologies, biotechnologies and nanotechnologies and cognitive technologies.

Table 1 Four Waves of the Industrial Revolution

Wave	Year	Characteristic features
1	1784	Vapour, water, mechanic production
2	1870	Division of labour, electricity, mass production
3	1969	Electronics, ICT, automated production
4	?	Cyber physical systems

Source: Schwab, 2016

Schwab (2016) mentions three reasons why the current transformation is not a simple prolongation of the third industrial revolution: these are its speed, scope and system effect. When compared to previous industrial revolutions the fourth one develops rather exponentially than linearly, with all resulting consequences.

Kopp and Basl (2017) state that it namely means the combination of new IT technologies, especially of Internet things and new production, transportation and industry, handling technologies plus new materials and related processes.

The German Institute of normalisation characterises the Industry 4.0 as a fusion of real and virtual world. There will be a world in which the information technologies are fully integrated in production processes. Systems in production, logistics or services will communicate with each other in a new, intelligent way. Thanks to the Industry 4.0 the production cycles get shortened, need of clients are registered in real time or the maintenance is mostly automatized (DIN, 2017).

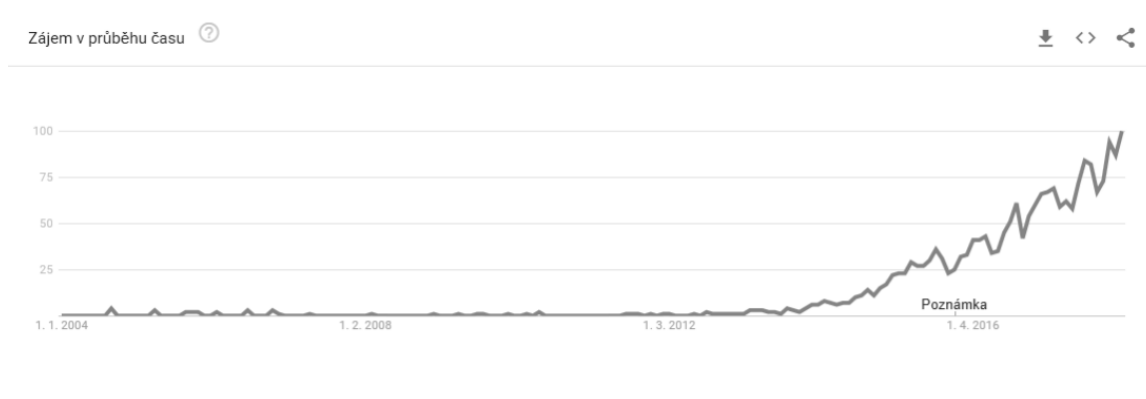
The term Industry 4.0 is characterised by the European Union (namely the European Parliament) as a notion for a group of quick transformation in design, production, operation and use of systems (European Union, 2015).

The Industry 4.0 trend is also important for the Czech Republic. That is why the government of the Czech Republic have approved its "Industry Initiative 4.0". The goal of the government is to strengthen the long-term cooperation of the competitiveness of the Czech Republic. In addition, this initiative tries to show possible directions that could support the Czech economy and industry and at the same time help to prepare the company for absorbing of this trend (Mařík, 2015).

In general, we can define the concept Industry 4.0 as a transformation of production as a separate automatized plant into a fully automatized and optimised production environments.

The interest in the issue of the Industry 4.0 nearly exponentially grows in last days, as shows the figure 1.

Figure 1 Interest in Searching of the Notion "Industry 4.0" at Google as per 30.4.2018 (100 % = maximum within the monitored period).



Source: Google (2018)

Although the Industry 4.0 namely relates to new approaches in implementation of new technologies in the production, this process is closely linked to financial records of inputs, intermediate outputs and outputs – to the accounting system. Many authors Chena and Thais (2016), Veza, Mladineo and Gjeldum (2015), Schuh, Popente, Varandani and Schmitz (2014) discuss the production optimisation. The other discuss the standardisation of communication tools and software interfaces but the way how the accounting systems are changing and will change during the fourth industrial revolution have not been described yet.

This text aims to analyse, using a case study, the readiness for the Industry 4.0 and to describe the accounting system within the context of incoming industrial revolution.

2 Methodology and Data

The company that was chosen for the case study is a small engineering company that deals with modular production, it has 25 employees and the annual turnover about 70 million CZK.

It is evaluated based on five levels of digital company maturity (MPO, 2018).

1. The company has its established information system for production management, its Internet presence is passive (web page). The company starts to consider the digitalisation of processes, production, maintenance, product design etc. It has no defined digital strategy. There is even a partial capability to be linked in information flows within customer-client relations. The basic economic software enables it to communicate with some public administration authorities.

2. There is its interactive web presence, the company is software-controlled, it starts to understand the importance of data. There are first integration projects, partial automatization, they consider the setting of digital strategy. There is a connection to information flows of customer-client chains (interconnected digital component codebooks, interactive digital catalogues, semi-automated orders, etc.).

3. Multi-channel presence (web, mobiles and tablets, social networks, etc.), the company has its defined digital strategy. The presence of data culture foundations projects, integration of data architecture, integrated automatization controlled in real time (MES), personalised products with virtual component.

4. Integrated multi-channel presence in digital world. In the company, there is a distributed and personalised digital strategy. The data architecture is integrated within whole production chain, from the communication and data sharing with the client up to the sub-suppliers. The use of digital diagnostics for prediction of failures and non-conformances in systems (production systems, measurement systems, etc.).

5. The company is a digitalisation platform connecting the online and the offline worlds in one fully integrated and economically effective ensemble. It offers a unique personalised experience to its clients through virtual products/assistants communicating with clients during the whole life cycle of the partnership relation. Through the advanced and most effective approaches (full automatization, 3D print, etc.) it performs the cyber-physical system able of individualised performance of eventual physical part of the product. It provides digitalised services to its partners and sub-suppliers and thus it globally controls the domain area.

3 Results and Discussion

It was found that the monitored company does not achieve at all nor the first level of readiness for the Industry 4.0. It has no implemented information system for production control. The production is scheduled based on physical book of orders. The order sheets are made in simple office programs but for the production itself they are passed in printed form. Nor the supplier-customer relations are controlled with information systems. The administered web pages are only passive.

Within the production the start of third industrial revolution rather comes in the analysed company as only two year ago the first automatized machine was bought, using a grant.

Kopp and Basl (2017) has found in their empiric research that only 11,17 % of companies is today preparing or performing pilot projects regarding this topic of the Industry 4.0.

In addition they found that micro companies (up to 10 employees) was not taking care of the industrial trend 4.0. What is more important, even the small and middle companies (from 50 to 250 employees) do only little for it. To date only 14,81 % of companies within the research of small companies are getting acquainted with this trend and only 11,6 % of middle companies within this category are about solving this trend.

The situation is different as for the accounting software, probably thanks to the fact that there is a pressure from public authorities and legislation so that the company is forced to present accounting outputs in electronic form.

When creating the documents for the public administration, the file undergoes the check of data and the erroneous file is automatically refused. This control removes the sending of error messages.

The company has adopted well the electronic form of accounting documents so that it receives and sends its accounting documents in electronic form.

This was supported with the amendment of VAT Act that allowed, since 2013, the electronic tax document without electronic signature. Provided both parties agree on it and the document has all appurtenances it can be considered as valid. (Act on accounting No. 563/1991 Sb.)

The tax document does not need to contain nor a stamp nor a signature of document issuer. (Strouhal, Židlická, Knapová, Cardová, 2012).

It shall be noted that about seventy percent of tax documents are still in printed form in the company. The tax documents are send in electronic form only due to costs and time savings. They are in pdf format and after being received they are printed and processed as the documents received in paper form.

It is highly probable that the electronically sent invoices in current pdf format will be replaced by invoices in xml format, QR codes, etc. in the future that will enable their reading directly into the accounting system of the receiver. In addition to data copying, the error rate shall also disappear.

Now they have a format enabling the import of bank statements through the Internet banking. Before it was necessary to account every item of the statement separately. Today it works so that the bank statement is imported, but also its items are automatically accounted, with conforming value and variable payment symbol.

The XML formats enable the transfer of large volume of data in relatively small file. Such format are used not only for the communication with the public administration, but they could be also used within the company.

The analysed company owns a common accounting program that can currently import also document and list agendas: invoices, orders, offers, demands, receipt vouchers, release notes, transfer notes, production internal documents, cash documents, sale notes, jobs, addresses, storages, division of stocks, storages, stocktaking list, account coding, user's lists, code series, groups of stocks, etc. All such agenda is also able to export, including balances and account day books. These exports/imports are not used by the company, besides the bank statements.

Till today no business partner has asked for sending of an invoice in XML format.

Besides the analysis of accounting system it is necessary to discuss also effects of the Industry 4.0 on the work of book-keepers.

Vacek (2016) thinks over competencies, knowledge and skills that will be necessary for working with smart technologies. He notes that today the computers still do not manage to perform a simple work with people. The division of work, based on substitutability of people by machines, includes four groups:

- Work that can be done by people but robots can do it better (weaving machines, autopilot, mortgage pricing, tax declarations, evaluation of x-ray images),
- Work that the people cannot do but the robots can (serial processing, computer chips, web browsers)
- New works that can be done by robots (robotic surgery, remote control, computer games)
- Work that can be done only by people (personal services – taking care, education, doctors, art, athletics)

Brynjolfsson and McAfee (2014) state that the technological progress will bring, with advantages, also the loss of jobs based on performance of routine tasks, not only manual but also cognitive ones.

The question what jobs will be most endangered by the automatization is answered by Carl. B. Frey and Michal A. Osborne in their study "The Future of Employment" (2013) and they have concluded that during next 20 years about 47 % of jobs will be endangered, whereas the most secure, i.e. not endangered, are those that are hardly automatized and require developed cognitive knowledge, creativity, social and emotional intelligence.

There is a study that presents the methodology for estimation of job loss endangered by the automatization (Batten Institute, 2015).

Chmelař (2015) has performed the similar study in the Czech Republic. The general administrative workers, index of endangering by digitalisation 0,08, other officers 0,96, cashiers 0,93. On the contrary, the managing workers are endangered much less.

It result from the above stated that the routine work of book-keepers is much endangered.

Vacek (2016) note that the best way how to keep the job is to equip people with correct knowledge and skills.

Hennies and Raudjävrv (2015) write that the employees shall accept other way of thinking and learn the integration in modern processes.

The role of book-keepers will change more and more quickly than in other professions.

In the future, the book-keepers shall have such knowledge and competencies to be able to manage and program new events. Their job will include not data insertion but data administration.

4 Conclusions

It was found that the monitored company does not reach nor the first level of readiness to the Industry 4.0 and that it has automatized its operation recently and thus launched its third industrial revolution.

It results from the above stated analysis of accounting system that the monitored company is conservative and passive to changes and that the largest move forward is made there where it is required by legislative conditions.

Within the performed analysis and outputs of other empiric studies this trend can be generalised for most of micro and small companies

As soon as the legislative requirements will change or under the pressure of large business partners it is probable that the work of book-keepers would change. The documents will be automatically loaded into the accounting system and thus the routine work of book-keepers will change in a highly professional and qualified work.

References

Act no. 563/1991 Coll., on Accounting, as amended.

Batten Institute (2015). *Innovation in the Age of Smart Machines*. Retrieved from: <http://issuu.com/batteninstitute/docs/smartmachines-120414-issuu>.

Brynjolfsson, E., McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. New York: W. W. Norton.

DIN (2017). *What is Industry 4.0?* DIN – German Institute for Standardization. Retrieved from: <http://www.din.de/en/innovation-and-research/industry-4-0/what-is-industry-4-0>.

European Union (2015). *Industry 4.0: Digitalisation for productivity and growth*. Retrieved from: [http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568337/EPRS_BRI\(2015\)568337_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568337/EPRS_BRI(2015)568337_EN.pdf).

Frey, C. B., Osborne, M. (2013). *The Future of Employment: How susceptible are jobs to computerisation?* Retrieved from: <http://www.oxfordmartin.ox.ac.uk/publications/view/1314>.

Google (2018). *Trends*. Retrieved from: <https://trends.google.com/trends/explore?date=all&q=Industry%204.0>, 30.4.2018

Halenár, I., Juhásová, B., Juhás, M. (2016). Design of a communication schema in a modern factory in accordance with the standard of industry 4.0. *Research Papers: Faculty of Materials Science and Technology, Slovak University of Technology in Trnava*, vol. 24(39), pp. 101-109.

Hennies, M., Raudjarv, M. (2015). Industry 4.0 Introductory thoughts on the current situation. *Eesti Majanduspoliitilised Vaitlused*, vol. 23(2).

Chena, T., Tsai, H. (2016). *Ubiquitous manufacturing: Current practices, challenges, and opportunities. Robotics and Computer Integrated Manufacturing*. Retrieved from: <http://dx.doi.org/10.1016/j.rcim.2016.01.001>.

Chmelař A. (2015). *Dopady digitalizace na trh práce v ČR a EU*. Retrieved from: <https://www.vlada.cz/assets/evropske-zalezitosti/analyzy-EU/Dopady-digitalizace-na-trh-prace-CR-a-EU.pdf>.

Kopp, J., Basl, J.(2017). Study of the Readiness of Czech Companies to the Industry 4.0. *Journal of Systems Intergration*, vol. 8(3), pp. 39-45.

Mařík, V. (2016). *Průmysl 4.0 – Výzva pro Českou republiku*. Praha: Management Press.

Mařík, V. (2015). *Průmysl 4.0*. Retrieved from <http://www.mpo.cz/dokument162351.html>.

MPO (2018). *Informace o situaci a opatřeních*. Retrieved from: http://ipodpora.odborny.info.../Informace_o_situaci_a_opatrenich.doc.

Roblek, V., Meško, M., Krapež, A. (2016). A Complex View of Industry 4.0. *SAGE Open*, vol. 6(2).

Schwab, K. (2016). *The Fourth Industrial Revolution: what it means, how to respond*. Retrieved from: <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>

Schuh, G., Potente T., Varandani, R., Schmitz, T. (2014). Global Footprint Design based on genetic algorithms – An „Industry 4.0“ perspective. *CIRP Annals – Manufacturing Technology*, vol. 63, pp. 433-436.

Strouhal, J., Židlická, R., Knapová B. (2012). *Účetnictví 2012. Velká kniha příkladů*. Brno: BizBooks.

Vacek, J. (2016). Průmysl 4.0 a společenskovoědní výzkum. *Trendy v podnikání*, vol. 6(2), pp. 29-38.

Veza, I., Mladineo, M., Gjeldum, N. (2015). Managing Innovative Production Network of Smart Factories. *International Federation of Automatic Control*, pp. 555-560.

Capital Creation Factors in Selected Banking Sectors of Europe

Jan Horvat¹, Eva Horvatova²

¹ Jan Horvat graduated University of Economics in Bratislava
E-mail: jhorvat@gmail.com

² University of Economics in Bratislava
Faculty of National Economy, Department of Banking and International Finance
Dolnozemska cesta 1, 85235 Bratislava, Slovakia
E-mail: eva.horvatova@euba.sk
&
Masaryk University Brno
Faculty of Business Administration
Lipová 41a, 800 00 Brno, Czech Republic
E-mail: eva.horvatova@econ.muni.cz

Abstract: *This article has the objective to examine the impact of the financial crisis on the banking sector, especially in terms of whether the change in approach to the regulation of banks contributed to the reduction of cyclical developments of the European banking sector. We analyzed the banking sectors of Germany, France and the Central and Eastern European banks for the period 2000-2013 (72 banks from Germany and France and 39 banks of Central and Eastern European countries). We have examined capital formation and pretax profit as a prerequisite for capital formation through panel regression. We used data from BankScope. We have come to the conclusion that there were different trends in capital formation in the countries of Western Europe on the one hand and in CEE countries on the other hand during the financial crisis.*

Keywords: financial crisis, bank capital

JEL codes: G01, G18

1 Introduction

Globalization and the strong interconnectedness of economies and financial systems have caused that local crises and inequalities have the potential to trigger a global crisis. These are signals that point to the need to use regulatory mechanisms that can respond quickly to stimuli of the real economy and financial markets, anticipate further developments in time and prevent the negative consequences of such developments.

Regulatory issues are at the forefront of financial theory and practice in the context of the financial crisis. In this context, the issue of banking regulation represented by Basel III, its interaction with the banking sector, the financial market and the real economy is also particularly relevant. Use citation continuously in the text.

The role of regulation and supervision of the financial system is mainly to limit risks in financial intermediation and in financial services.

The primary task of regulation and supervision of banks is to ensure stability in terms of the stability of the banking system or the internal stability of individual banks. Ensuring the stability of the banking system requires the fulfillment of a number of conditions in macroeconomic and microeconomic approaches, in setting up the business environment of financial institutions in a way that promotes sustainable economic growth and the stability of financial institutions.

The relationship of the individual authors of the regulation is varied. In some opinions, the view is that the problem of banks is caused by insufficient regulation; in others, on the other hand, it is stated that over-regulation can be a problem.

There are unequal attitudes to valuation. There are supporters of valuation at market prices, seeking to realistic representation of risk; on the other hand, there are opinions

that suggest that market prices are significantly influenced by cycles and further exacerbate pro-cyclicality.

Many views take into account partial issues, but a comprehensive view of the problem is to take account of several aspects of the solution, and seek a healthy degree of regulation that should support the stability and sustainable profitability in the banking sector.

For example, Stiglitz, J. (Stiglitz, 2010) states that "regulation can greatly contribute to the prevention of negative phenomena, but it may also be that an inadequate form, scope or method of regulation is a source of new crises."

The interdependence of the development between the real economy and the financial sector needs to be analyzed from a number of perspectives. Individual regulatory acts have different specific objectives, but most regulatory measures are motivated by creating conditions for greater financial and banking stability and the elimination of moral hazard.

Especially important is the look at the pro-cyclicality of regulation and the relationship between the economic cycle and the financial crisis, especially the influence of regulation on the cyclicity of developments in the banking sector and the real economy. There are many models that focus on predicting financial crises or leading indicators. We are told that financial crises can be predicted, but they cannot be avoided; just mitigate their impacts or timely regulatory measures. Significant leading indicators include, for example, composite leading indicators that can predict in the short term the potential negative development of the economy (Jakubíková, Tkáčová, Banciová, 2014).

According to Van Hoose (Van Hoose, 2007), the primary effect of any system of capital requirements is to change the leverage effect of the bank's portfolio, the ratio between capital and assets. It is clear that the result will be a change in the asset portfolio of the financial institution.

Van Hoose states that the authors Koehn and Santomero (Koehn, Santomero, 1980) pointed out that banks that were not risk averse had higher capital requirements but also a higher probability of bankruptcy. It is not possible to effectively reduce the risk by regulation as subject to regulation is not the composition of assets.

Van Hoose finally raises the question of whether risk-based capital regulation really makes individual banks and the banking system as a whole "safer". Relative growth of "capital cushion" can quickly dissipate if the banks do not respond by not holding the portfolios of risky asset classes or will not generate sufficient measures to evaluate the adverse selection or moral hazard. Author defends the idea that banks are portfolio managers, and that this approach gives qualified support for capital regulation.

We have also been inspired by research that addressed the relationship between capital and risk decision, behavior of banks, because this is a key link in the regulation of capital (Tanda, 2015). The author points out the differences in behavior of banks according to the selected characters. Its benefit is mainly in comparison to several studies and methods used in them.

The positive impact on capital may be found when the asymmetry of information (Gropp, Heider, 2010) suggests that large banks hold higher capital buffers to offset their increased complexity. The author reports recent studies confirming that banks could hold liquidity as a shock insurance and use it as a bumper, which limits the need for additional capital (Jokipii and Milne, 2011), while other banks (such as small banks) capital to compensate for the lack of liquidity (Distinguin et al., 2013).

2 Methodology and Data

We compiled models that would allow determining the relationship between capital, loans and bank profits. Panel regression combines cross-sectional data over time. The informative value of it is higher compared to linear regression. The data structure is compiled to capture each bank (i) at all times (t). The cross-sectional dimension is expressed as i, which takes values from 1 to N, in our case the number of banks (72 banks

from Germany and France and 39 banks of Central and Eastern European countries). We have had observations for the period 2000-2013. The advantages of panel regression are that we can get a more accurate estimate of the parameters of the proposed model.

Model Specification (Other heading – not numbered, Verdana 10, bold)

Our data was "balanced panel", meaning we had data for the same time period for each of the same banks without missing values.

The basic model for panel regression is a linear model in shape

$$y_{it} = \alpha_{it} + \beta_{it}^T x_{it} + u_{it} \quad (1)$$

where:

$i = 1, \dots, N$ = cross-sectional index,

$t = 1, \dots, T$ = time index,

u_{it} = random error.

Component α_{it} contains omitted observations, such as some bank characteristics that are not part of explanatory variables.

In practice, two models are used: Fixed Effects Model and Random Effects Model. For the purpose of deciding which model is significant, we will use the Hausman test.

3 Results and Discussion

Research is focused on the analysis of the largest banking sectors, in Germany and France, because we consider these banking sectors to be crucial to the stability of the Eurozone and the economies of Germany and France are the most powerful economies of Western European countries.

The panel regression was done in several alternatives. The first was the analysis of the German and French banks within one set for the period 2000-2013. We then divided the banks by country, on the German banks and on the French banks into separate files.

We then analyzed the time-sharing data, German banks from 2000 to 2013, and German banks for the period from 2008-2013, in order to find out the differences in the period of financial crisis.

Table 1 The Results of the Panel Regression on a Set of all Banks (Germany, France and CEE countries) for the Time Period 2000-2013

Type of Panel Regression Model	Pooling	Fixed	Random
Model 1: Common_Equity ~ Gross_Loans + Pretax_Profit + Total_Assets+ Fixed_Assets + Personnel_Expenses			
(Intercept)	686.029 ***		687.887 ***
Gross_Loans	0,0758 ***	0,042 *	0.0490 *
Pretax_Profit	-0,063 *	-0.052 .	-0.052 .
Total_Assets	0.069 **	0.044 .	0.044 .
Fixed_Assets	-0.0386	-0.018	-0.022
Personnel_Expenses	-0.067 *	-0.015	-0.029
Model 2: Common_Equity ~ Gross_Loans + Pretax_Profit + Total_Assets + Fixed_Assets			
(Intercept)	645.565 ***		670.230 ***
Gross_Loans	0,073 ***	0,041 *	0,048 *
Pretax_Profit	-0.064 *	-0.050 .	-0.054 .
Total_Assets	0.066 **	0.038	0.044 .
Fixed_Assets	-0.035	-0.019	-0.022
Model 3: Common_Equity ~ Pretax_Profit + Total_Assets			
(Intercept)	692.084 ***		701.12 ***

Pretax_Profit	-0.054	.	-0.045	-0.047	.
Total_Assets	0.049	*	0.029	0.033	.
Model 4: Pretax_Profit ~ Total_Assets + Bank_Deposits + Customer_Deposits + Net_Loans					
(Intercept)	553.654	***		511.035	***
Total_Assets	-0.017		0.042	*	0.029
Bank_Deposits	-0.041	*	-0.018		-0.023
Customer_Deposits	0.051	**	0.035	*	0.038
Net_Loans	0.069	**	0.070	**	0.070

Source: Data from BanScope, own processing

As first we analyzed the complex of all banks (Western European and Eastern European banks).

Common equity creation supported gross loans and total assets. Pretax profit has a negative relationship with the creation of common equity. It points to the fact that the pro-cyclicality of banks in dataset for the period 2000-2013 was not overcome. Net profit and customer deposits supported the creation of pretax profit. In all 1-4 models, Hausman's test recommended a fixed-effect model.

Table 2 The Results of the Panel Regression on a Set of Banks of Germany and France 2000-2013

Type of Panel Regression Model	Pooling	Fixed	Random
Model 1: Common_Equity ~ Gross_Loans + Pretax_Profit + Total_Assets + Fixed_Assets + Personnel_Expenses			
(Intercept)	462.4057 ***		465.869 ***
Gross_Loans	-0.022185	-0.0547 *	-0.0490 *
Pretax_Profit	-0.016511	-0.0138	-0.0148
Total_Assets	0.098646 ***	0.05191	0.0597 *
Fixed_Assets	-0.019975	-0.0124	-0.0117
Personnel_Expenses	-0.069995 *	0.02827	-0.0012
Model 2: Common_Equity ~ Gross_Loans + Pretax_Profit + Total_Assets + Fixed_Assets			
(Intercept)	430.565 ***		465.41 ***
Gross_Loans	-0.02516	-0.0540 ***	-0.0491 *
Pretax_Profit	-0.01283	-0.0136	-0.0148
Total_Assets	0.098055 ***	0.0506	0.0596 *
Fixed_Assets	-0.014588	-0.0110	-0.0117
Model 3: Common_Equity ~ Pretax_Profit + Total_Assets			
(Intercept)	414.812		439.064 ***
Pretax_Profit	-0.015862	-0.0224	-0.0226
Total_Assets	0.093326	0.0450	0.0544 *
Model 4: Pretax_Profit ~ Total_Assets + Bank_Deposits + Customer_Deposits + Net_Loans			
(Intercept)	303.394 ***		274.294 ***
Total_Assets	-0.0337	0.0331	0.0162
Bank_Deposits	-0.0331	-0.0193	-0.0236
Customer_Depo	0.0281	0.0233	0.0242
Net_Loans	0.0954 ***	0.0894 ***	0.0910 ***

Source: Data from BanScope, own processing

In the observed banks of Germany and France, the gross loans growth did not lead to capital growth, which may mean that loans were low-risk or that other items of balance (for example securities) were growing more. Capital growth is accompanied by a fall in profit. It points to the fact that the pro-cyclicality of the banks in this dataset for the period

2000-2013 was not overcome. Growth of assets contributed to capital growth from 0.02 to 0.059 per unit of capital growth. The fourth model shows that assets contributed to profit making and that customer deposits supported the bank's profit creation. In all 1-4 models, Hausman's test recommended a fixed-effect model.

Table 3 The Results of the Panel Regression on a Set of Banks of Germany 2000-2013

Type of Panel Regression Model	Pooling	Fixed	Random
Model 1: Common_Equity ~ Gross_Loans + Pretax_Profit + Total_Assets+ Fixed_Assets + Personnel_Expenses			
(Intercept)	1.5743e+05 *		1.7708e+05 *
Gross_Loans	-8.3173e-03 *	-0.052443 ***	-1.8117e-02 ***
Pretax_Profit	1.0528e+00 ***	0.9160364 ***	1.0199e+00 ***
Total_Assets	7.8964e-03 ***	0.01161073***	8.8705e-03 ***
Fixed_Assets	2.7751e+00 ***	-0.10846301	2.6265e+00 ***
Personnel_Expenses	2.7902e+00 ***	2.21013379***	3.1522e+00 ***
Model 2: Common_Equity ~ Gross_Loans + Pretax_Profit + Total_Assets + Fixed_Assets			
(Intercept)	1.4478e+05		1.7478e+05*
Gross_Loans	1.4646e-02***	-0.044119 ***	6.6787e-03***
Pretax_Profit	1.1232e+00 ***	0.9410463***	1.1076e+00***
Total_Assets	1.1793e-02 ***	0.0116712***	1.3154e-02***
Fixed_Assets	5.3427e+00***	0.15231367	5.6720e+00***
Model 3: Common_Equity ~ Pretax_Profit + Total_Assets			
(Intercept)	3.6526e+05***		7.9228e+05**
Pretax_Profit	1.0516e+00***	0.7292069***	7.9112e-01***
Total_Assets	1.9271e-02***	0.0073521***	1.0397e-02***
Model 4: Pretax_Profit ~ Total_Assets + Bank_Deposits + Customer_Deposits + Net_Loans			
(Intercept)	8.2294e+03	-0.001342***	2.6190e-03 ***
Total_Assets	-1.0539e-03 **	0.0424408***	1.1271e-02 ***
Bank_Deposits	1.5060e-02 ***	0.00248213	-3.4823e-02 ***
Customer_Deposi	-1.0685e-02 ***	-0.01663 ***	1.5966e-02 ***
Net_Loans	3.2428e-03	-0.001342***	2.6190e-03 ***

Source: Data from BanScope, own processing

In the observed German banks, capital growth and profit growth are positively correlated. Growth of assets most prominently contributed to capital growth (from 1.03% to 8.8% per unit of capital growth). On this basis, it is possible to assume that other groups of assets contributed to the risk of the banking sector, which was subsequently taken into account in capital formation.

In the observed German banks, capital growth was not accompanied by credit growth, which shows, as in the previous set (Germany and France), in the better case, that the loan was similarly low risk, or worse, pro-cyclicality in these banking sectors was present.

Loans have contributed to profit growth, which can be considered as positive, because loans are the most yielding asset. Customer's deposits are in negative terms with the profit. We could also see that banks could not make money on deposits during the period of general decline in interest rates.

4 Conclusions

As first we analyzed the complex of all banks (Western European and Eastern European banks).

Common equity creation supported gross loans and total assets. Pretax profit has a negative relationship with the creation of common equity. It points to the fact that the pro-

cyclicality of banks in dataset for the period 2000-2013 was not overcome. Net profit and customer deposits supported the creation of pretax profit.

In the set of banks of Germany and France, the gross loans growth did not lead to capital growth and capital growth is accompanied by a fall in profit. Growth of assets contributed to capital growth. The used model shows that assets and customer deposits contributed to profit creation.

In the observed German banks, capital growth and profit growth are positively correlated. Growth of assets most contributed to capital growth, capital growth was not accompanied by credit growth. Loans have contributed to profit growth, which can be considered as positive, because loans are the most yielding asset. Customer's deposits are in negative terms with the profit. We could also see that banks could not make money on deposits during the period of general decline in interest rates.

It points to the fact that the pro-cyclicality of the banks in this dataset for the period 2000-2013 was not overcome and that support for anti-cyclicality in regulation is the right way.

Acknowledgments

The research was created in the framework of the OP R & D Project entitled "Creating an Excellent Center for Economic Research for the Challenge of Civilization Challenges in the 21st Century" (ITMS 26240120032) "We support research activities in Slovakia"/ the project is co-financed from EU sources, by the Slovak Science Foundation VEGA, project VEGA 1/0693/17, project MUNI/A/1092/2017 and project KEGA 030EU-4/2017. All support is greatly acknowledged.

References

- Distinguin, I., Roulet, C., Tarazi, A. (2013). Bank regulatory capital and liquidity: Evidence from US and European publicly traded banks. *Journal of Banking and Finance*, vol. 37(9), pp. 3295–3317.
- Gropp, R., Heider, F. (2010). The determinants of bank capital structure. *Review of Finance*, vol. 14(4), pp. 587–622.
- Jakubíková, E., Tkáčová, A., Bánociová, A. (2014). Kompozitné predstihové indikátory hospodárskych cyklov krajín V4 a ich komparácia s CLI Eurostatu. *Politická ekonomie*, vol. 2014(2).
- Jokipi, T., Milne, A. (2011). Bank capital buffer and risk adjustment decisions. *Journal of Financial Stability*, vol. 7(3), pp. 165–178.
- Koehn, M., Santomero, A. (1980). Regulation of bank capital and portfolio risk. *Journal of Finance*, vol. 35, pp. 1235–1244.
- Stiglitz, J. (2010). *Freefall*. London: Penguin Group. ISBN 978-0-141-04512-2.
- Tanda, A. (2015). The Effects of Bank Regulation on the Relationship Between Capital and Risk. *Comparative Economic Studies*, pp. 31–54.
- Van Hoose, D. (2007). Theories of bank behavior under the capital regulation. *Journal of Banking & Finance*, vol. 31, pp. 3680–3697.

Efficiency of Banks in Slovak Republic

Eva Horvatova

University of Economics in Bratislava
Faculty of National Economy
Department of Banking and International Finance
Dolnozemska cesta 1, 85235 Bratislava, Slovakia
E-mail: eva.horvatova@euba.sk

&

Masaryk University Brno
Faculty of Business Administration
Department of Finance
Lipova 41a, 800 00 Brno, Czech Republic
E-mail: eva.horvatova@econ.muni.cz

Abstract: *The objective of this article is to examine the efficiency of Slovak banks in the time period 2000-2013. Slovak banking system faced serious problems connected with the process of transformation of the Slovak economy. They were manifested by difficulties in obtaining of long-term resources, with keeping of capital adequacy requirements and with the rapid growth of the non-performing loans. Transformation and privatization of large banks led to improvement of financial stability and efficiency of banking sector. As first we used a combination of fixed assets and staff costs as input and net interest margin as output in terms of CCR and BCC-I models. In the next analysis we used the combination of three factors - fixed assets and loan-loss provisions as inputs and volume of credits as output in terms of CCR and BCC-I models. Both cases show that the banks in Slovakia have too many fixed assets and high personnel costs with respect to the measured outputs; to the loans and to the net interest margins.*

Keywords: technical efficiency of banks, data envelope analysis

JEL codes: G01, G21

1 Introduction

Slovak banking system has undergone a major change and faced serious problems connected with the process of transformation of the Slovak economy. The three largest banks were VUB, SLSP and IRB. The deposits were concentrated in SLSP; the loans were concentrated in the VUB. IRB was specialized in the credits for cooperative housing.

The problems were manifested by difficulties in obtaining of long-term resources, with keeping of capital adequacy requirements and with the rapid growth of the non-performing loans. Money market instability was connected with the problem of high interest rates.

With regard to the extent of funds required to cover losses in the Slovak banking sector as an appropriate solution was the restructuring and subsequent sale of state-owned banks.

The role of pre-privatization restructuring of banks was to get banks into such a condition as to reach the required capital adequacy ratio and decreasing of the proportion of classified loans.

The bank as a business unit realizes economies of scale. These are resulting from economies of fixed costs. Fixed costs motivate debtors and creditors to form the coalitions in order to buy or sell together and so to reduce fixed costs per unit of transactions. Economies of scale are changing with the size of the banks.

DEA analysis belongs to the non-parametric methods of measuring efficiency. The disadvantage is the fact that it is impossible to separate the effect of random errors and errors in the measurement of inefficiency. DEA measures the relative efficiency of production units in the examined group of units.

Technical efficiency refers to the ability of banks to obtain the maximum amount of output from a given volume of inputs and indicates the minimum necessary input to produce a

given volume of output. In contrast, allocative efficiency takes into account the size of the bank as a production unit.

The efficient production units are located on the efficient frontier. Efficiency frontier indicates the maximum possible output for a given input using a given technology.

It is also necessary to take into account whether the production units operate in conditions of constant (CRS) or variable (VRS) returns to scale.

To the development of the theory and practice of using DEA models in the Czech Republic contributed authors such as Jablonský, J. and Dlouhý, M., Novosádová, I. (2004),

With the application of DEA Analysis deal for example Řepková, I. (2012).

In Slovakia, we can mention the works of Halická, M. (2014) and Vincová, K. (2006).

DEA model is used to assess the efficiency of the various production units - banks, universities, hospitals and others where we compare the inputs and outputs. For example, the work of authors Asandulua, L., Roman, M., Fatulescua, P. (2014) deal with the efficiency of EU health system. The efficiency of investments to information technologies evaluates the paper of authors Yao Chena, Liang Liangb, Feng Yangb, Joe Zhuc (2006).

In the article, the analysis of technical efficiency of Slovak banks uses the data of BankScope and National Bank of Slovakia. The analysis uses the standard tools of descriptive and analytical statistics and statistical program IBM SPSS. Statistical program MaxDEA is used for the DEA (Data Envelopment Analysis) applied to the example of the Slovak banks. Our aim was to examine whether the banks, which underwent a process restructuring and privatization have become more efficient after privatization.

2 Methodology and Data

For evaluation of Slovak banks efficiency was chosen the data envelope analysis (DEA) models. The DEA models are divided into two main groups: model with constant returns to scale - CCR model, and model based on variable returns to scale - BCC model. The models are further subdivided into input and output oriented models.

DEA analysis shows the relative efficiency. The theoretical nature of the DEA requires that subjects observed in the group of decision making units (DMU) have to be banks with similar focus.

Therefore, we omitted specialized banks (housing saving banks and state development and guarantee banks). The number of production unit has an impact on the number of analyzed factors in efficiency measurement.

Respecting the rules of DEA, the number of analyzed inputs and outputs was no more than one third of analyzed production units. It was analyzed 9 banks and the number of inputs and outputs was no more than 3.

Therefore, the analysis was conducted in combinations of several inputs and outputs.

Model Specification (Other heading – not numbered, Verdana 10, bold)

CCR-I (Charnes-Cooper-Rhodes-Input) model can be written in the (Jablonský, Dlouhý, 2004):

$$\max z = \sum_{i=1}^m u_i * y_{iq} \quad (1)$$

Under the conditions:

$$\sum_{i=1}^m u_i * y_{iq} \leq \sum_{j=1}^r v_j * x_{jk}; \quad k = 1, 2, \dots, n$$

$$\sum_{i=1}^m u_i * y_{iq} - \sum_{j=1}^r v_j * x_{jk} \leq 0 \quad k = 1, 2, \dots, n$$

$$\sum_{j=1}^r v_j * x_{jk} = 1$$

$$u_i \geq 0, i = 1, 2, \dots, m$$

$$v_j \geq 0, j = 1, 2, \dots, r$$

BCC-I (Banker-Charnes-Cooper-Input) model can be written (Jablonský, Dlouhý, 2004):

$$\max z = \sum_{i=1}^m u_i * y_{iq} + \mu \quad (2)$$

Under the conditions:

$$\sum_{i=1}^m u_i * y_{iq} + \mu \leq \sum_{j=1}^r v_j * x_{jk}; \quad k = 1, 2, \dots, n$$

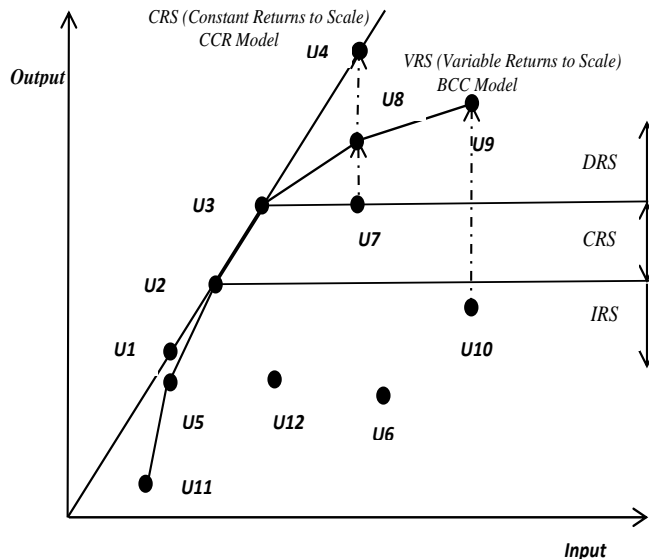
$$\sum_{j=1}^r v_j * x_{jk} = 1$$

$$u_i \geq 0, i = 1, 2, \dots, m$$

$$v_j \geq 0, j = 1, 2, \dots, r$$

Parameter μ reflects the conditions of convexity of the BCC-I model.

Figure 1 Efficiency Frontier at Constant Returns to Scale and Variable Returns to Scale



Source: Jablonský, J., Dlouhý, M.: Modely hodnocení efektivnosti produkčních jednotek. Praha: Professional Publishing, 2004

Where:

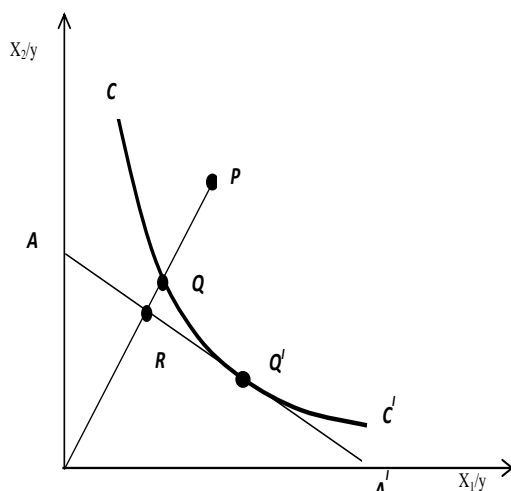
DRS = Decreasing Return to Scale

CRS = Constant Returns to Scale

IRS = Increasing Return to Scale

The efficiency frontier expresses the maximum possible output for a given input using a given technology. The efficient units are located on the CRS or VRS frontier. On the frontier CRS are efficient units U1, U2, U3 and U4, which operate under constant returns to scale. It means, if increase the input, the output will be increased in the same range. Units U11, U5, U2, U3, U8 and U9 are efficient at the efficiency frontier VRS. Increasing input is reflected by increasing or decreasing output growth (DRS = Decreasing Return to Scale, IRS = Increasing Return to Scale). Units U12, U6, U7 and U10 are inefficient. In order to become efficient, they should increase the output to reach to the frontier of efficiency. For example, unit U7 can get to the border VRS on the position of U8, or to efficiency frontier CRS on the position U4.

Figure 2 The Relationship Between Technical and Allocative Efficiency of Input Oriented Model



Source: Jablonský, J., Dlouhý, M.: *Modely hodnocení efektivnosti produkčních jednotek*. Praha: Professional Publishing, 2004

On the chart, the efficient frontier is on Isoquant CC^I . Production unit P is technically inefficient because it does not lie on CC^I . The rate of technical inefficiency is reflected by the distance to the CC^I . Production unit at Q produces the same amount of output as a unit P, but Q uses only part of inputs equal to OQ/OP .

Technical efficiency is therefore expressed as the ratio OQ/OP . The line AAI is the isocost, its slope is determined by the ratio of input prices. Allocative efficiency will be expressed as the ratio OR/OQ . The total efficiency is expressed as the product of technical and allocative efficiency, on the basis of which we obtain that the total efficiency is equal to the ratio OR/OP .

3 Results and Discussion

The restructuring of the banking sector in Slovakia was an important factor for of establishing macroeconomic equilibrium, and further privatization of banks. Foreign capital entered into the privatized banks. Into VUB entered Italian banking group Intesa BCI, into SLSP entered Austrian Erste Bank and into IRB - Hungarian OTP Bank. The aim of privatization was to create and maintain a stable banking system, banking system comparable to developed countries, as well as its involvement in the European financial structures (Chudják, F., Hallon, Ľ., Leková, A, 2016).

The privatization of the largest Slovak banks has brought pluses in form of standard professional banks managements. These changes have contributed to improving the functioning of banks and to increase their efficiency and stability. The analysis assesses the efficiency of banks studying the relationship of inputs to the selected outputs indicators.

DEA analysis of selected Slovak banks

In the next section we will discuss the issue of efficiency banks that were included in the process of state restructuring and subsequent privatization.

To set the analyzed banks were included commercial banks; specialized banks, state guarantee bank and housing-saving banks we have excluded. It remained in the file 9-12 banks, so we had to use a combination of inputs and outputs in the total number of three indicators.

As first was used a combination of fixed assets (F), staff costs (C) as input and net interest margin (M) as output, which further will be referred to as a combination of inputs and outputs "FCM". The results in terms of CCR and BCC-I Models are in following Table 1.

Several cases of inefficiency banks indicate that Slovak banks persist at a high level of fixed assets and personnel costs. The privatized banks had to reduce staff costs, which contributed to their effectiveness. Net interest margin as output assumes that banks fulfil a mediating function in standard conditions. Reducing interest rates on deposits is not a sufficient condition for growth of the interest margin; a very significant is the volume of credits.

The values in the table can be represented graphically clearer and points out that the banks that were included in the restructuring and privatization were more efficiently above average in the coming periods after 2001. Our analysis also showed that Bank 6 and Bank 9 during the reporting period were according to the criteria highly efficient. In case of Bank 9, has confirmed the high efficiency even at other combination of inputs and outputs.

In the next analysis was used the combination of three factors: fixed Assets (A), loan-loss provisions (P) as inputs and volume of credits (L) as output. In the next text will bet his combination signed as „FPL“. The results in terms of CCR and BCC-I Models are in the Table 2.

Taking into account fixed assets and loan-loss provisions as the inputs and credits as an output; the highest efficiency reaches the Bank 9, which was efficient by the BCC-I Model for all the observed period.

From the privatized banks the best level of efficiency has had Bank 1, and Bank 2; both banks were privatized by foreign banks. Weaker results reached Bank 3.

Graphical values can be expressed in the Figure 2 and Figure 2.

In this case, the input (FPM) fixed assets (F) and personnel costs (P) and the output, the net interest margin (M).

Table 1 The Coefficients of Efficiency in Terms of CCR and BCC-I Model for the Combination of Inputs and Outputs “FCM”

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average
Bank1 CCR	1	0,99	0,73	0,79	1	0,99	0,32	0,95	0,94	0,9	0,77	0,91	1	0,86	0,867
Bank1 BCC	1	1	0,77	1	1	1	0,32	1	1	1	1	1	1	1	0,935
Bank2 CCR	0,91	0,93	1	0,74	0,89	0,94	1	1	1	1	1	0,99	1	0,96	0,954
Bank2 BCC	0,91	1	1	0,94	0,89	1	1	1	1	1	1	1	1	1	0,981
Bank3 CCR	0,7	1	0,55	0,51	0,77	0,75	0,28	0,67	0,67	0,65	0,55	0,63	0,81	0,85	0,670
Bank3 BCC	0,88	1	1	0,56	0,8	0,76	0,31	0,71	0,77	0,72	0,59	1	1	1	0,792
Bank4 CCR	0	0	0	0	0,8	0,72	0,26	0,67	0,79	0,72	0,59	0,58	0,77	0,67	0,469
Bank4 BCC	0	0	0	0	0,8	0,76	0,27	0,68	0,82	0,74	0,59	0,58	0,82	0,74	0,485
Bank5 CCR	0	1	1	0,5	0,5	0,85	0,37	0,93	0,64	0,57	0,55	0,55	0,86	0,71	0,645
Bank5 BCC	0	1	1	0,5	0,56	0,85	0,38	0,94	0,65	0,59	0,56	0,69	0,87	0,76	0,667
Bank6 CCR	0,69	0,84	0,1	1	0,79	0,87	1	1	1	1	1	1	1	1	0,877
Bank6 BCC	1	1	1	1	0,83	0,89	1	1	1	1	1	1	1	1	0,98
Bank7 CCR	0	0	0	0,78	0,89	1	0,33	0,77	0,5	0,53	0,36	0,52	0,35	1	0,502
Bank7 BCC	0	0	0	0,78	0,95	1	0,33	0,79	0,55	0,58	0,39	0,92	1	1	0,592
Bank8 CCR	0	0	0	0,81	0,86	0,83	0,26	0,69	0,52	0,62	0,48	0,5	0,61	0,55	0,480
Bank8 BCC	0	0	0	0,81	0,96	0,85	0,31	0,73	0,6	0,69	0,52	1	1	0,83	0,592
Bank9 CCR	0,51	1	0,96	1	0,9	0,88	0,53	0,8	0,7	0,64	0,55	0,58	0,72	0,76	0,752
Bank9 BCC	1	1	1	1	1	1	0,54	1	1	1	0,98	0,84	0,72	0,86	0,921
Average	0,48	0,653	0,562	0,707	0,849	0,886	0,484	0,851	0,786	0,77	0,693	0,793	0,862	0,863	

Source: Data from BankScope, own processing

Table 1 The Coefficients of Efficiency in Terms of CCR and BCC-I Model for the Combination of Inputs and Outputs “FCM”

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average
Bank1 CCR	1	0,43	1	0,31	0,32	0,24	0,19	0,5	0,58	0,57	0,12	0,66	0,83	1	0,553
Bank1 BCC	1	0,43	1	1	1	0,93	0,58	1	1	1	1	1	0,83	1	0,912
Bank2 CCR	1	0,02	0,3	1	0,38	0,3	0,14	0,34	0,33	0,26	0,11	0,34	1	0,75	0,447
Bank2 BCC	1	0,23	0,39	1	0,88	1	0,46	0,45	0,33	0,34	0,34	0,78	1	1	0,657
Bank3 CCR	0,57	0,21	1	0,3	0,6	0,47	0,29	0,62	0,58	0,52	0,09	0,56	0,74	0,59	0,51
Bank3 BCC	0,9	0,41	1	0,44	0,83	1	0,6	0,66	0,61	0,57	0,41	1	1	1	0,745
Bank4 CCR	0	0	0	0	1	1	0,25	0,37	0,52	0,48	0,34	0,63	0,81	1	0,457
Bank4 BCC	0	0	0	0	1	1	0,54	0,44	0,52	0,59	0,69	1	0,89	1	0,547
Bank5 CCR	0	1	0,34	0,33	0,46	0,28	0,45	1	1	0,84	0,28	1	1	0,91	0,635
Bank5 BCC	0	1	1	0,51	0,54	0,71	1	1	1	0,9	1	1	1	1	0,832
Bank6 CCR	0,54	0,19	0,23	0,17	0,14	0,02	0	0,35	0,55	0,55	0,07	0,66	0,48	1	0,353
Bank6 BCC	1	1	1	0,21	0,16	0,07	0	0,4	0,56	0,62	0,5	0,8	1	1	0,594
Bank7 CCR	0	0	0	1	1	0,38	0,3	0,29	0,94	1	0,1	0,65	0,37	0,79	0,487
Bank7 BCC	0	0	0	1	1	0,85	0,97	0,7	0,95	1	0,6	0,99	1	1	0,718
Bank8 CCR	0	0	0	1	0,48	0,27	0,23	0,56	0,66	0,71	0,06	0,96	0,38	0,79	0,435
Bank8 BCC	0	0	0	1	0,48	0,52	0,48	0,56	0,67	0,77	0,73	1	0,96	0,92	0,577
Bank9 CCR	1	1	0,89	0,66	0,67	0,49	0,41	0,82	1	0,92	0,49	0,77	1	1	0,794
Bank9 BCC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Average	0,50	0,384	0,508	0,607	0,663	0,585	0,438	0,614	0,711	0,70	0,440	0,822	0,849	0,930	

Source: Data from BankScope, own processing

4 Conclusions

As first we used a combination of fixed assets (F), staff costs (C) as input and net interest margin (M) as output, which further will be referred to as a combination of inputs and outputs signed as "FCM". We then combined three factors: fixed assets (A), loan-loss provisions (P) as the inputs and volume of credits (L) as an output. This combination was signed as „FPL“.

In both cases it appears that the banks in Slovakia identified as inefficient have too many fixed assets and high personnel costs with respect to the measured outputs, i.e., to the loans and to the net interest margins.

DEA analysis clearly shows by a several criteria examined by the banks in Slovakia that were privatized banks from Western Europe. These banks are long-term stable and more efficient than other banks in Slovakia. A comparable result gave Bank 9, which was from its start owned by the Reiffesen Zentralbank.

Figure 3 and figure 4 show that the restructured and privatized banks 1-3 have overcome the crisis with greater efficiency. DEA analysis provides interesting results because it highlights the efficiency as the ratio between inputs and outputs, as a view on performance. This is not identical with profitability.

From the privatized banks the best level of efficiency has had Bank 1 and Bank 2.

Restructuring and privatization of banks in Slovakia so fulfills its historic role, as banks privatized by Western European banks are efficient and investors are strategic because they hold their investments to present.

Acknowledgments

The research was created in the framework of the OP R & D Project entitled "Creating an Excellent Center for Economic Research for the Challenge of Civilization Challenges in the 21st Century" (ITMS 26240120032) "We support research activities in Slovakia"/ the project is co-financed from EU sources, by the Slovak Science Foundation VEGA, project VEGA 1/0693/17, project MUNI/A/1092/2017 and project KEGA 030EU-4/2017. All support is greatly acknowledged.

References

- Asandulua, L., Roman, M., Fatulescu, P. (2014). The efficiency of healthcare systems in Europe: a Data Envelopment Analysis Approach. *Procedia Economics and Finance*, vol. 10, pp. 1-366.
- Halická, M. (2014). *DEA modely*. Bratislava: Univerzita Komenského.
- Chudják, F., Hallon, Ľ., Leková, A. (2015). *Centrálne bankovníctvo v stredoeurópskom priestore*. Bratislava: National Bank of Slovakia in cooperation with the Institute of the History of the Slovak Academy of Science. ISBN 978-80-8043-202-7.
- Jablonský, J., Dlouhý, M. (2004). *Modely hodnocení efektivnosti produkčních jednotek*. Praha: Professional Publishing. ISBN 80-86419-49-5.
- Jablonský, J., Dlouhý, M., Novosádová, I. (2007). Využití analýzy obalu dat pro hodnocení efektivnosti českých nemocnic. *Politická ekonomie*, vol. 2007(1), pp. 60–71.
- Řepková, I. (2012). Measuring the efficiency in the Czech banking industry: Data Envelopment Analysis and Malmquist index. In: Ramík, J. and Stavárek, D., eds., *Proceedings of 30th International Conference Mathematical Methods in Economics*. Karviná: Silesian University, School of Business Administration, pp. 781–786. ISBN 978-80-7248-779-0.
- Vincová, K. (2006). Neefektívnosť z rozsahu v bankovom sektore: Komparácia slovenského a českého bankového sektora. In: *International Conference Proceedings: National and*

Regional Economics VI. Košice: Ekonomická Fakulta, Technická Univerzita v Košiciach, pp. 440–445.

Zimková, E. (2014). Technical Efficiency and Super-efficiency of the Banking Sector in Slovakia. *Procedia Economics and Finance*, vol. 12, pp. 780–787.

Yao C., Liang B., Feng Y., Joe Z. (2006). Evaluation of information technology investment: a data envelopment analysis approach. *Computers & Operations Research*, vol. 33, pp. 1368-1379. Retrieved from: <http://www.deafrontier.net/papers/CORIT.pdf>.

Impact of Macroeconomic Factors on the Value of Loans Granted to Non-Financial Enterprises by Monetary Financial Institutions in the Euro Area Countries

Agnieszka Huterska¹, Robert Huterski², Justyna Łapińska³

¹ Nicolaus Copernicus University in Toruń
Faculty of Economic Sciences and Management
ul. Gagarina 11, 87-100 Toruń, Poland
E-mail: huterska@umk.pl

² Nicolaus Copernicus University in Toruń
Faculty of Economic Sciences and Management
ul. Gagarina 11, 87-100 Toruń, Poland
E-mail: robhuski@umk.pl

³ Nicolaus Copernicus University in Toruń
Faculty of Economic Sciences and Management
ul. Gagarina 11, 87-100 Toruń, Poland
E-mail: justlap@umk.pl

Abstract: *The use of low interest rates by the European Central Bank as an instrument to counteract the effects of the financial crisis in 2008 seemed to create favorable conditions for a significant increase in demand from non-financial corporations for loans granted by monetary financial institutions. Indeed, the demand for loans in individual euro area countries reported by non-financial corporations is shaped by both conditions common for the entire euro area and numerous factors reflecting the specificity of a given national economy. The aim of the article is to assess the impact of key macroeconomic factors on the size of lending to non-financial enterprises by monetary financial institutions in the euro area countries. The macroeconomic factors examined include GDP growth rate, unemployment rate, wage growth, inflation and the long-term interest rate according to the Maastricht criterion. The survey covers the euro area countries in 2008-2015, without Estonia and Latvia due to incomplete data for these countries for the above period. The data comes from the databases of the European Central Bank and Eurostat. For the purpose of assessing the above-mentioned factors, an econometric model based on panel data will be created.*

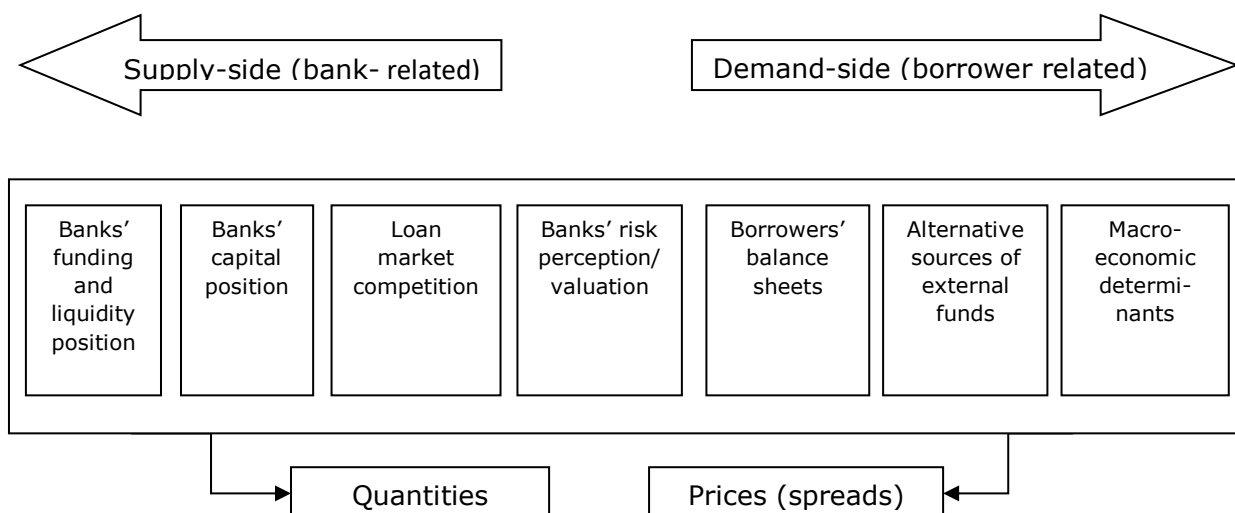
Keywords: *loans, credit, monetary financial institutions, non-financial corporations, panel data model*

JEL codes: C23, E51, F45, G21

1 Introduction

Geographically, the conducted research involved 17 out of 19 Eurozone countries. Only Estonia and Latvia were excluded due to lack of complete data from the studied period. When analyzing the potential factors which shaped the nominal value of loans granted by monetary financial institutions (MFI) to non-financial corporations (NFC) in Eurozone countries one should bear in mind the specificity of the 2008-2015 period under investigation. It was the beginning of a serious economic crisis leading to a breakdown in the total economic situation, which after a temporary improvement in 2011 suffered another, yet not so serious decline in years 2012-2013 (Dajcman 2016, p. 129). Years 2014-2015 brought a halt to this negative trend, but the improvement was still rather insignificant and meant only partial rebound after the losses suffered during the crisis. It influenced both the shape of macroeconomic independent variables, as well as the ones related to companies' financial results (Deutsche Bank 2017, p. 54).

Figure 1 Schematic Presentation of Supply and Demand-side Factors that Influence Loan Developments



Source: ECB (2011). Recent developments in loans to the private sector, ECB Monthly Bulletin, p. 65

The following sections will outline the potential mechanisms of impact exerted by independent variables on the value of loans granted by MFI to NFC (hereinafter referred to as MFI/NFC loans), which according to the used model proved to be statistically significant. As regards the macroeconomic indicators, they are real GDP growth rate, total unemployment rate and inflation rate. From the group of data related to companies' economic performance, the ones selected include production value, value added at factor cost (both output related) and gross investment in tangible goods (capital input related).

2 Methodology and Data

In order to identify the factors influencing the value of loans granted to NFCs by MFIs in the Eurozone, an econometric model for panel data has been created.

The dependent variables in the study were selected macroeconomic variables in particular Eurozone countries in the years 2008-2015. In the set of dependent variables there were: real GDP growth rate, total unemployment rate and inflation rate. The dependent variables, on the other hand, were also data concerning the results of company operation, such as production value, value added at factor cost (both output related) and gross investment in tangible goods (capital input related).

Model Specification

The model has the following form:

$$Loan_{jt} = \alpha_0 + \alpha_1 GDP_{gr_{jt}} + \alpha_2 Unemp_{jt} + \alpha_3 Inf_{jt} + \alpha_4 Prod_{jt} + \alpha_5 Val_add_{jt} + \alpha_6 Gross_Invest_{jt} + v_{jt} \quad (1)$$

$$v_{jt} = e_t + u_j + \varepsilon_{jt} \quad (2)$$

Table 1 presents the description of individual variables. The source of data was the Eurostat database.

Table 1 Variables Used in Empirical Investigation

Variables	Variables description
$Loan_{jt}$	Loans vis-a-vis euro area NFC reported by MFI excluding ESCB in the euro area (stock EUR mln)
Explanatory variables	
GDP_gr_{jt}	Real GDP growth rate, percentage change on previous year,
$Unemp_{jt}$	Total unemployment rate (%)
LCI_wag_{jt}	Wages and salaries (total), percentage change on previous period
LCI_other_{jt}	Labour costs other than wages and salaries, percentage change on previous period
$Infl_{jt}$	HICP - inflation rate, Annual average rate of change
$Bonds_{jt}$	EMU convergence criterion bond yields (%); EMU convergence criterion series - annual data
$Prod_{jt}$	Production value (mln EUR)
Sur_{jt}	Gross operating surplus - SBS (mln EUR)
$Total_purch_{jt}$	Total purchases of goods and services (mln EUR)
Val_add_{jt}	Value added at factor costs (%)
$Gross_Invest_{jt}$	Gross investment in tangible goods (mln EUR)
v_{jt}	The random error in the object j , in the time period t , which consists of the following components: e_t – impulses affecting all observations in the time period t , u_j – impulses affecting all the observations in the object j , ε_{jt} – impulses affecting only observations in the object j , in the time period t .

Source: elaborated by the authors

3 Results and Discussion

In this study, for the purpose of describing the dependencies between macroeconomic variables and the value of loans granted by MFI to NFC in the Eurozone countries, a panel model defined by Formula (1) was used. The data was collected for 17 Eurozone counties. They concern an 8-year period (annual data for 2008-2015).

The panel data model (1) was estimated using GRETL (GNU Regression Econometrics Time-Series Library) software. The choice of estimation method was made based on the decision-making procedure proposed by subject literature in econometrics (Baltagi 2001). First, the estimation of a simple panel model was made using a classical least squares method (without individual effects), and the model's diagnostic tests were conducted. The following values of test statistics were obtained: Wald test ($F=50,7397$; $p\text{-value}\approx 0,0000$), Breusch-Pagan test ($LM=249,124$; $p\text{-value}\approx 0,0000$) and Hausman test ($H=27,3913$; $p\text{-value}=0,00225757$).

When analyzing the Wald test results it can be concluded that the appropriate model describing the dependencies between macroeconomic variables and the value of loans granted by MFI to NFC in the Eurozone is a fixed effects one (FEM). The results of Breusch-Pagan point to a random effects model (REM) as a more reliable one. Finally, the results of Hausman test allow to conclude at the risk of error at the level of 0,05 ($\alpha=0,05$) that the best model for describing the studied relationship the best tool will be fixed effects model (FEM). Further analysis of the model's properties, however, has confirmed the present of heteroscedasticity of the random component. In order to eliminate this flaw, for the purpose of estimating the model's parameters weighted least squares (WLS) method was used.

Table 2 presents the results of estimation for the above model.

Table 2 The Results of Estimation of the Model Describing the Determinants of Loans Granted by MFI to NFC in the Eurozone Countries

Dependent variable $LOAN_{jt}$					
Independent variables	Coefficient	Std. Error	t-ratio	p-value	Significance ^{a)}
Constant	-217819	38094,9	-5,718	<0,0001	***
GDP_gr_{jt}	-1713,32	693,088	-2,472	0,0147	**
Unemp_{jt}	4157,04	995,310	4,177	<0,0001	***
Inf_{jt}	3676,36	1707,40	2,153	0,0332	**
Prod_{jt}	0,210133	0,0243009	8,647	<0,0001	***
Val_add_{jt}	5011,94	863,832	5,802	<0,0001	***
Gross_Invest_{jt}	2,08509	0,328226	6,353	<0,0001	***
Observations			136		
Standard error of residuals			0,771125		
R ²			0,979654		
Adjusted R ²			0,978708		
F (6, 129) = 1035,221			p-value for test F < 0,00001		

a)*** The statistically significant variable at the level of 1%; ** The statistically significant variable at the level of 5%.

Source: the author's own calculations

The estimated model is correct in statistical terms. Among eleven potential independent variables six turned out to be statistically significant. All the obtained signs of the evaluations of structural parameters of independent variables are in accordance with the theoretical predictions.

The obtained results allow to conclude that five independent variables have a positive influence on the dependent one (i.e. the value of loans granted by MFI to NFC). Among those variables there are: total unemployment rate (Unemp_{jt}) inflation rate (Inf_{jt}), production value (Prod_{jt}), value added at factor cost (both output related) (Val_add_{jt}) and gross investment in tangible goods (capital input related) (Gross_Invest_{jt}). Interpretation of parameter estimation in the cases of particular variables is relatively simple. For example, a parameter estimation for the Unemp_{jt} variable (4157,01) should be interpreted as follows: if the unemployment rate grows by one percentage point, then the value of loans granted by MFI to NFC in the surveyed group of countries will as a result grow by approximately EUR 4157.01 mln, assuming the stability of other variables.

The research findings confirm that the factor which has a strong, and at the same time negative, influence on the shape of dependent variable is the real GDP growth rate (GDP_gr_{jt}).

In the estimated model, the variables which turned out to be statistically insignificant were: labour cost index - wages and salaries (LCI_wag_{jt}), labour costs other than wages and salaries (LCI_other_{jt}), EMU convergence criterion bond yields (Bonds_{jt}), gross operating surplus (Sur_{jt}) and total purchases of goods and services. (Total_purch_{jt}).

The econometric model for panel data used in the study does not take into account time shifts as a reaction of dependent variable to the shape of independent variable. It means that the model's results do not determine the possibility of observing the results of the impact of dependent variables on the stock of MFI/NFC loans in the subsequent period or periods (Louri and Migiakis 2016, p. 40).

Regardless of the above, the clearly negative impact of real GDP growth rate on stock of MFI/NFC loans revealed by the model within a given time unit (year) has a logical explanation, confirmed by other observations. In the periods when the total economic situation improves companies have better possibilities of funding their activities from current revenues. However, if the improvement is not strong enough to encourage companies to radically expand the range of their activities, including funding their turnover-related needs or investments by means of loans from MFI, then the demand for such funds may decrease in relation to periods of worse economic situation (ECB 2009, p. 19). It is a phenomenon also known from the studies of the channels of transmission of the impulses of the central bank's monetary policy. It proves that in countries that are inflation-stable the factor of greater influence on banks' loan-related activities than loan availability to enterprises (including the costs of loans reflected in interest rates), is companies' optimism concerning adequately large increase in the market's power of absorption of their production at the prices which are satisfactory for them (Mishkin 1996, p. 3 and 10). This results in a broader assumption which is crucial for this model and any elaborations based on it, according to which the stock of MFI/NFC loans is shaped to a much greater extent by the described significant variables than the other way round.

As noted above, due to the outcomes of the financial crisis, at the beginning of the studied period the real GDP growth rate in the Eurozone experienced a breakdown, and its later increase was related to the reconstruction of the size of economic activity to the level from before the crisis, which was uneven in the course of time. One should also consider other factors, such as the increase in the attractiveness of financing large companies' needs by emission of securities on the capital market (both shares and bonds), which typically accompanies improvements in the total economic situation (Covas and den Haan 2006, p. 30).

The impact of the rising unemployment rate shown by the model on the growth of the stock of MFI/NFC loans should also be associated with the specific economic situation in connection with the financial crisis. Companies make more people redundant in the periods of economic downturn, when they become more dependent on sustaining their financial condition with loans. At the same time, a radically growing unemployment rate is evidence of increased size of a low-income social group, which reduces the society's consumption potential, influencing companies' financial results (PwC 2010, p. 22). State-funded unemployment benefits may to a certain extent reduce the decline, but not eliminate it. The process of companies' adapting to the new circumstances is neither immediate nor complete (Verick and Islam 2010, p. 36). In terms of increased unemployment, the financial crisis from 2008 created an especially difficult situation for countries from southern Europe, such as Greece, Portugal, Spain, Italy, as well as Ireland.

The impact of inflation on the stock of MFI/NFC loans (expressed in millions of EUR) seems obvious due to the very essence of inflation as a common increase in prices (and salaries) and its impact on the values expressed nominally in money. The results of the calculations, however, have confirmed that the impact was at a lower level of significance than in the case of unemployment. The article deliberately makes use of the HICP measure of inflation and not the industrial producer price index, which has a very direct impact on the stock of loans granted to enterprises. A separate analysis would be required for the potential influence on the results exerted by the inflation (and interest rates) level which is close to zero, or even by deflation (and negative real interest rates) in the Eurozone countries in the studied period (Plasil et al. 2013, p. 129).

Production value (millions of EUR) measured as the amount actually produced by the unit, based on sales, including changes in stocks and the resale of goods and services demonstrates a significant influence on the stock of MFI/NFC loans. It can be treated as evidence that an increase in the production value contributed to increased optimism by NFCs in the Eurozone regarding the profitability of further expansion with the use of loans from MFI. The loans taken may, of course, have a reciprocal influence on the increase in the production value (Martinez and Landesberger 2010, p. 12).

Also, the value added at factor costs (in %), which is the gross income from operating activities after adjusting for operating subsidies and indirect taxes, according to the used model, has significant influence on the stock of MFI/NFC loans. Due to its nature, the mechanism of influence described at the production value should be even more visible in relation to gross income from operating activities (Cesaroni et al. 2016, p. 4). An increase in the production value does not always translate into an increase in the gross income, for instance due to falling profit margins or growing costs of production and prices, which means that an increase in the production value may be accomplished even with the same profit margin and smaller amount of product sold.

According to the definition by Eurostat, gross investment in tangible goods (expressed in millions of euro) is defined as investment during the reference period in all tangible goods. Included are new and existing tangible capital goods, whether bought from third parties or produced for own use, having a useful life of more than one year. However, the measure also includes non-produced tangible goods such as land, but investments in intangible and financial assets are excluded from it (EIB, p. 31). When analyzing the significant influence of investments on the stock of MFI/NFC loans, one should thus bear in mind that what is meant here is a special type of investments in relations to loans in general, which include both investment loans, as well as working capital loans and others. Essentially, an increase in the investment in tangible goods, apart from causing an increase in demand for investment loans, should at least partially increase the demand for working capital loans, and even other types of loans.

4 Conclusions

Interest in factors which influence the value of loans granted by MFI to NFC gained a new dimension when from September 2016 the Bank for International Settlements (BIS) started publishing time series on the credit-to-GDP gap for more than 40 economies. According to BIS, the credit-to-GDP gap is defined as the difference between the credit-to-GDP ratio and its long-run trend, and captures the build-up of excessive credit in a reduced-form fashion. It has been found to be a reliable early warning indicator of impending financial crises for a broad array of countries and a long time span that includes the most recent crisis. According to ECB data, the value of loans granted by MFI to NFC reacted to the 2008 crisis with greater downturns than the value of household loans (ECB 2011, p. 63).

Analyses conducted in the course of research indicate that the shaping of the value of loans granted by MFI to NFC in the Eurozone is influenced not only by selected macroeconomic factors, but also values related to the results of companies' economic activity. As regards the macroeconomic indicators, they are real GDP growth rate ($GDP_{gr_{jt}}$), total unemployment rate ($Unemp_{jt}$) and inflation rate ($Inflation_{jt}$). From the group of data related to companies' economic performance, the ones selected include production value ($Prod_{jt}$), value added at factor cost ($Val_{add_{jt}}$) – both output related – and gross investment in tangible goods ($Gross_Invest_{jt}$ – capital input related). An important one, whose influence is negative, is real GDP growth rate. A positive impact of macroeconomic indicators on the value of MFI/NFC loans in the Eurozone was discovered in the case of the total unemployment rate and inflation rate. All indicators of the results of the economic activity of enterprises that turned out to be statistically significant, that is production value, value added at factor cost and gross investment in tangible goods, have a clearly positive impact on the value of loans granted. The tendencies shown by all the factors which determine the value of MFI/NFC loans in the Eurozone countries have turned out to be in line with the theoretical assumptions.

Acknowledgments

The paper was developed as part of the project "Positive social change in an organization as a factor of a company engagement in sustainable development". The project was funded by the National Science Centre, Poland, on the decision number DEC-2017/25/B/HS4/01113.

References

- Baltagi, B. H. (2001). *Econometric Analysis of Panel Data*. Chichester: John Wiley & Sons Ltd.
- Cesaroni, T., De Bonis, R., Infante, L. (2016). On the determinants of firms' financial surpluses and deficits. In: *8th IFC Conference Statistical implications of the new financial landscape*. Basel: Irving Fisher Committee on Central Bank Statistics, BIS, pp. 1-24.
- Covas, F., den Haan, W. J. (2006). The Role of Debt and Equity Finance over the Business Cycle. *Bank of Canada Working Paper*, no. 2006-45.
- Deutsche Bundesbank (2017). Recent developments in the indebtedness of the private non-financial sector in selected euro-area countries. *Deutsche Bundesbank Monthly Report*, pp. 41-58.
- ECB (2009). Loans to the non-financial private sector over the business cycle in the euro area. *ECB Monthly Bulletin*, vol. October 2009, pp. 18-21.
- ECB (2011). Recent developments in loans to the private sector. *ECB Monthly Bulletin*, pp. 57-72.
- EIB (2015). *Investment and Investment Finance in Europe. Investing in competitiveness*. Economics Department, European Investment Bank.
- Louri H., Migiakis, P. M. (2016). Bank Lending Margins in the Euro Area: The Effects of Financial Fragmentation and ECB Policies. *LSE 'Europe in Question' Discussion Paper Series*, Paper no. 105/2016.
- Martinez-Carrascal, C., von Landesberger, J. (2010). Explaining the money demand of non-financial corporations in the euro area – a macro and a micro view. *ECB Working Paper*, no. 1257, pp. 4-32.
- Mishkin, F. S. (1996). The Channels of Monetary Transmission: Lessons for Monetary Policy. *NBER Working Paper*, no. 5464, pp. 1-27
- Plašil, M., Radkovský, Š., Řežábek, P. (2012/2013). *Modelling bank loans to non-financial corporations*. Czech National Bank, Financial Stability Report 2012/2013, pp. 128-136.
- PwC (2010). *Bank lending and the recovery*. UK Economic Outlook, pp. 18-22.
- Trabelsi, M. A. (2012). The impact of the sovereign debt crisis on the eurozone countries. *Procedia - Social and Behavioral Sciences*, vol. 62, pp. 424 – 430.
- Verick S., Islam, I. (2010). The Great Recession of 2008-2009: Causes, Consequences and Policy Responses. *Forschungsinstitut zur Zukunft der Arbeit, IZA Discussion Paper*, no. 4934.

Convergence of the Government Bond Yields in Estonia, Latvia and Lithuania

Jana Hvozdenka

Masaryk University
Faculty of Economics and Administration, Department of Finance
Lipova 41a, 602 00 Brno, Czech Republic
E-mail: 174974@mail.muni.cz

Abstract: *The aim of this paper is to analyse the influence of the European Union accession and financial crisis to convergence and integration of the bond yields and bond markets. The results show the deepening of bond market convergence after the European Union accession and the integration has continued until the end of the observed period. The chosen indicators are monthly mid-term bond yields (10-year bond yields). The period of 1/2000 to 12/2017 was chosen in order to show the impacts of the changes. The time period was divided into periods 1/2000 - 4/2004 (before the European Union accession), 5/2004 - 7/2007 (after the accession and before financial crisis), 8/2007 - 3/2009 (period of the deepest financial crisis), 4/2009 - 12/2016 (period after the financial crisis). Used methods are 1) spread between the 10-year bond yields of countries of Estonia, Latvia, Lithuania and German 10-year bond yield, 2) analysis of alignment, 3) β -convergence. These findings can be beneficial for the financial market observers.*

Keywords: β -convergence, bond yields, integration of bond markets

JEL codes: E43, E44, E47, G01

1 Introduction

The financial turmoil during 2007-2009 affected the euro area financial sector in ways that differ considerably across market segments and countries. A consequence was a temporary reduction of market activity within national borders. The impact was felt most strongly in the money markets, and relatively less in bond activities. However, economic growth stopped and still many countries are not able to follow Maastricht Convergence Criteria.

On one hand, the integrated financial markets and the common currency may help protect the countries from the negative impacts of a financial crisis, because the countries are part of a large, stable economic unit. On the other hand – financial instability may spread easily from country to country, since barriers to the capital movements have been reduced.

Across the economic literature, there is a range of acceptable definition of financial integration. In a broader sense, it is possible to achieve financial integration when all the conditions necessary for the continuous implementation of financial transactions and market functioning are met.

Commonly-used definition of financial integration is expressed by (Baele et al., 2004). The market for a given set of financial instruments and services is fully integrated if all potential market participants with the same relevant characteristics (1) face a single set of rules when they decide to deal with those financial instruments and services; (2) have equal access to the above-mentioned set of financial instruments and services; and (3) are treated equally when they are active in the market.

Financial markets are integrated when the law of one price holds (Adam et al., 2002). This states that assets generating identical cash flows command the same return, regardless of the domicile of the issuer and of the asset holder. Given this definition, financial market integration can be measured by comparing the returns of assets that are issued in different countries and generate identical cash flows.

(Czech National Bank, 2012) states that it is possible to speak about the achievement of full integration of financial markets only if financial assets with comparable risk factors and yields are evaluated by the markets in the same way, regardless of the country where the

assets are traded. Fully integrated markets without any barriers permit to use an arbitrage opportunities which lower the importance of local factors characteristic for given countries and enable direct comparison of the prices of financial assets in individual markets.

The aim of this paper is to analyse the influence of the EU accession and financial crisis to convergence and integration of the bond yields and bond markets.

2 Theoretical Concepts

In general, the convergence of government bond yields to a stable level with reduced risk aids the overall economy, by allowing cheaper access to debt financing with less uncertainty regarding the value of such funds over time. This, in turn, stimulates investment and output within converging countries.

The methods described below are used for measuring of bond market integration.

Spread between Yield on a Local Asset and a Well-Chosen Benchmark Asset

Germany is the biggest and most solid economy within the EU. For that reason it can be chosen as the benchmark asset for the countries of European Union. The smaller the spread is the bigger the integration is.

Formally we can write the convergence in time t and $t+1$ as:

$$|y_{1,t} - y_{2,t}| > |y_{1,t+1} - y_{2,t+1}| \quad (1)$$

where $y_{1,t}$ and $y_{2,t}$ are relevant economic variables of two countries in time t .

The case with opposite sign is called divergence. This is a situation when the countries in terms of economic maturity are moving away.

Analysis of Alignment

Analysis of alignment is the first step of the concept of financial integration. It is based on the correlation analysis in standard or rollover form. This analysis indicates the strength of a linear relationship between two variables. Its value may not be sufficient for the evaluation of this relationship, particularly in those cases where the assumption of normality is incorrect. The correlation coefficients, being aggregated statistics, cannot substitute for individual evaluation of the data (Babečý et al., 2007).

Concept of β -convergence

β -convergence (2) is used to determine the approximation rate of asset returns in financial markets. It was first used by (Adam et al., 2002). In order to quantify β -convergence, it is possible to apply regression according to the following formula:

$$\Delta R_{i,t} = \alpha_i + \beta R_{i,t-1} + \sum_{l=1}^L y_l \Delta R_{i,t-l} + \varepsilon_{i,t} \quad (2)$$

where $R_{i,t}$ represents the distribution rate of specific assets between a country i in time t with respect to the reference territory, Δ is the reference operator, α_i is a specific constant for the given country, $\varepsilon_{i,t}$ is a white noise disturbance. Lag length L is based on Schwarz Criterion, maximal length is set to 1, because monthly data are applied and financial market memory is relatively short. β -coefficient is a direct criterion of the rate of global market convergence.

The concept of beta-convergence enables identification of the speed with which eliminated differences in yields on individual financial markets. If the beta coefficient is negative, then signals the existence of convergence and the amount of beta coefficient expresses the convergence rate, i.e. the rate of elimination of shocks to the yield differential pricing of individual assets to the euro area. The closer beta coefficient is to -1, the greater the speed of convergence is.

3 Methodology and Data

The selected countries are Estonia, Latvia and Lithuania.

As a measure of the yield was used 10-year government bond yield in all countries mentioned above and Germany (monthly basis). Germany is the biggest and most solid economy within the EU. For that reason it can be chosen as the benchmark asset for the chosen countries (and whole European Union). The data of 10-year sovereign bonds of the selected countries were taken from Bloomberg database (2018, [4]). The sample period starts from 1/2000 and ends on 12/2017. This time range covers the period before the accession of the countries to European Union (1/2000 – 4/2004), after the accession (5/2004 – 7/2007), period of financial crisis (8/2007 – 3/2009) and period after financial crisis (4/2009 – 12/2017). The beginning of the pre-crisis period (or the period of spectacular growth) coincides with an accession of the countries studied to the European Union. We decided to start the crisis period with a different date than that of the Lehman Brothers bankruptcy and major panic in the markets. We wanted to capture an earlier market, which was when the 2007 banking crisis changed from high expectations to the fear of a looming sovereign debt crisis. The pre-crisis period depicts a long run-up in prices followed by a significant price drop during the crisis period.

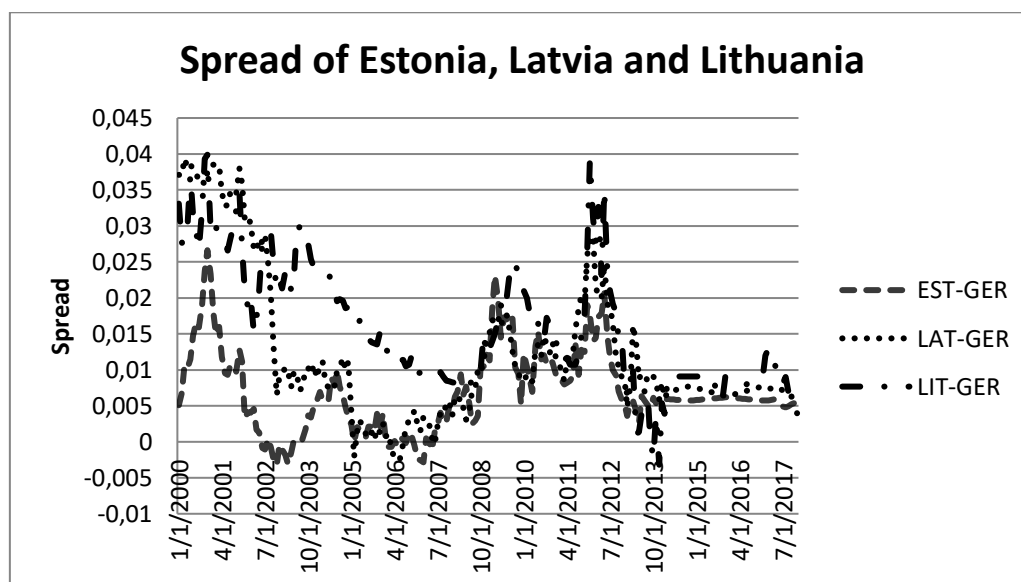
The used methods are: spread between the yield on a local asset and a benchmark asset, analysis of alignment and concept of β -convergence.

4 Results and Discussion

We used the methods described above to measure the bond markets integration.

Spread between Yield on a Local Asset and a Well-Chosen Benchmark Asset

Figure 1 Spread of Estonia, Latvia and Lithuania



Source: author's calculations

As we mentioned above, the benchmark asset is German 10-year government bond yield. The spreads between Estonia and Germany, Latvia and Germany, Lithuania and Germany are possible to see in Figure 1.

The closer the spread is to zero the bigger the convergence is. It is clearly visible that regarding to the Estonia and Latvia the spreads are the closest to zero between the years 2002 and 2007. The biggest spreads has Lithuania – in 2008 and 2013 the spreads are bigger than 2.5 %. The financial crisis and later on debt crisis had the biggest impact on Lithuania (because of the highest spreads), however we can see that the spreads were quite similar in all countries.

It is possible to say that according to this criterion, the most integrated country is the Estonia (because of the lowest spread).

Analysis of Alignment

Simple period average correlations of 10-year bond yields, shown in Table 1, show that Estonian, Latvian and Lithuanian markets are strongly linked (in whole period) among themselves (correlations between 0.68 and 0.89), on the other hand with the Germany as well (correlations between 0.65 and 0.88). Bold numbers indicate strong and significant correlation coefficients.

Table 1 Correlations during 1/2000 –12/2017

1/00-12/17	EST	LAT	LIT	GER
EST	1			
LAT	0.897542	1		
LIT	0.689547	0.75958	1	
GER	0.884586	0.84783	0.654875	1

Source: author's calculations

Table 2 Correlations during 8/2007 – 3/2009

8/07-3/09	EST	LAT	LIT	GER
EST	1			
LAT	0.32033	1		
LIT	0.36646	0.123614	1	
GER	0.16006	0.220882	-0.2907	1

Source: author's calculations

Table 2 shows the time period with the lowest correlation coefficient. It is the period of financial crisis. In this case it is possible to see that countries are not correlated at all among themselves. No country is correlated to Germany. Table 3 shows the best results – time period from April 2009 to December 2017. It is the period after financial crisis and it was expected that the government bond yields should show the highest correlations.

Table 3 Correlations during 4/2009 – 12/2016

4/09-12/17	EST	LAT	LIT	GER
EST	1			
LAT	0.95859	1		
LIT	0.815875	0.92458	1	
GER	0.82535	0.764582	0.795685	1

Source: author's calculations

Concept of β -convergence

The results of β -convergence are in Table 4. All the values in the table are negative. It means that there is a convergence in the bond markets of the selected countries. The p-values are mainly less than chosen significance level of $\alpha=0.01$, therefore we can contribute the models as significant.

Table 4 β Coefficients

	1/00 – 4/04		5/04 – 7/07		8/07 – 3/09		4/09 – 12/17	
	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value
EST	-0.758	1.11e-021 ***	-	1.68e-07 ***	-	0.866	-	3.89e-12 ***
LAT	-0.359	1.49e-044 ***	-	1.78e-09 ***	-	0.9308	-	5.47e-06 ***
LIT	-0.895	2.42e-045 ***	-	9.87e-015 ***	-	0.1020	-	6.49e-07 ***

Source: author's calculations

The only exception is in all selected countries (Estonia, Latvia and Lithuania) in the period of financial crisis (8/07-3/09).

Relatively high values of β coefficient indicate that individual financial markets of observed economics integrated relatively easily with the German market. The β coefficient was relatively low in Lithuania during the financial crisis. It means that Lithuania started to diverge and in the period after financial crisis started quickly converge to benchmark. The divergence may be caused by increased nervousness of financial market participants and the associated increase in the volatility of market assets. Both investors and investment services providers in fear of their liquidity position restricted their market activities, including cross-border activities and integration process more or less weakened.

The absolute values of the β coefficients are close to one for all the countries in the period after financial crisis. It means that the levelling of newly arising differences between the chosen country and the Germany is fast.

The tests of normality and homoscedasticity are shown in the Table 5. For the evaluation of the normality test is probably the easiest to observe the result from graph of the assumed normal distribution in comparison to the actual distribution of residues and analyse p-values of Chi-square test. We test the hypothesis H0: Residuals are normally distributed, against the hypothesis H1: Residuals are not normally distributed, the significance level of α was chosen as 0.01. If the p-value is greater than α then we cannot reject the H0, therefore the residuals are normally distributed.

For the testing of heteroscedasticity we chose the White's test. We test the hypothesis H0: Constant variances of residuals – homoscedasticity, against H1: Heteroscedasticity. The significance level of α was chosen as 0.01. If the p-value is greater than α then we cannot reject H0, therefore it contributes homoscedasticity.

Table 5 Tests of Normality and Homoscedasticity

	1/00-4/04		5/04-7/07		8/07-3/09		4/09-12/17	
	P-value norm.	P-value heteros.	P-value norm.	P-value heteros.	P-value norm.	P-value heteros.	P-value norm.	P-value heteros.
CZ	0.378	0.277	0.150	0.633	0.178	0.475	0.225	0.345
SK	0.827	0.597	0.592	0.258	0.267	0.526	0.268	0.236
PL	0.0204	0.157	0.448	0.270	0.367	0.873	0.194	0.275

Source: author's calculations

5 Conclusions

In this paper we have discussed the selected aspects of bond integration of Estonia, Latvia and Lithuania. The aim of this paper was to analyse the influence of the EU accession and

financial crisis to convergence and integration of the bond yields and bond markets of selected countries.

Are the bond markets of the selected countries group convergent? Answering this question requires a surprising amount of preliminary work. According to all used methods the markets converge more after the financial crisis than before, however they converge for the whole observed period of time. Surprisingly all methods showed and confirmed lower pace of integration in Lithuania in the period of financial crisis, which rose in the period after the financial crisis. The divergence in the period of financial crisis may be caused by increased nervousness of financial market participants and the associated increase in the volatility of market assets.

Future research could be extended to a wider examination of integration of the stock markets. It would be interesting to test if there would be a change in results when using data of EU15 as an average of the oldest members of European Union instead of Germany as the most stable economy.

Acknowledgments

Support of Masaryk University within the project MUNI/A/1092/2017 Financial stability and economic development is gratefully acknowledged.

References

Adam K. et al. (2002). *Analyse, Compare and Apply Alternative Indicators and Monitoring Methodologies to Measure the Evolution of Capital Market Integration in the European Union*. Palermo: University of Palermo, CSEF.

Babecký J. et al. (2007). Financial Integration of Stock Markets among New EU Member States and the Euro Area. *ČNB Working Paper Series No 7*. Prague: Czech National Bank, 2007.

Baele L. et al. (2004). Measuring Financial Integration in the Euro Area. *ECB Occasional Paper Series No 14*. Frankfurt am Main: European Central Bank.

Bloomberg (2018). *10-year Government Bond Yields*. Retrieved from: Terminal Bloomberg.

Česká národní banka (2012). *Analýza stupně ekonomické sladění České republiky s Eurozónou*. Praha: Česká národní banka.

A Relationship between Gender and Age Diversity among Board Members and Firm Performance

Lenka Janošová¹, Petr Mikuš²

¹ Masaryk University
Faculty of Economics and Administration, Department of Business Economics and Management
Lipová 41a, 602 00 Brno, Czech Republic
E-mail: lenkajanosova@mail.muni.cz

² Masaryk University
Faculty of Economics and Administration, Department of Business Economics and Management
Lipová 41a, 602 00 Brno, Czech Republic
E-mail: 62765@mail.muni.cz

Abstract: *This paper provides an evidence that age diversity in managing and supervisory boards among Czech joint-stock companies has impact on firm's performance indicators. Age diversity is becoming widely discussed topic due to population ageing, which is reflected in corporate governance area as well. Age diversity can influence decision-making process, risk attitude or structure of assets, that's why it has impact on overall profitability of businesses. The main goal of our paper is to test possible relationship between age composition of supervisory and executive board members in Czech stock companies and firm performance. The initial sample included 364 companies with Czech domicile operating in manufacturing industry, especially in IT industry. Randomly chosen sample is composed of 70 Czech companies from IT industry. For this sample we gained basic data describing the number of board members, their age, gender as well as current key performance indicators published financial statements (ROA, ROS, liquidity, indebtedness). We use these indicators to assess the relation between age diversity and profitability through basic statistic and mathematic methods.*

Keywords: *age diversity, gender diversity, Key Performance Indicators (KPI), ROA, ROS*

JEL codes: *M14, M21, M12, L25, L22*

1 Introduction and literature review

With an increasing rate of globalization, a growing public interest and increasing competitive pressure, an interest in the efficiency and functioning of corporate governance is increasing. Although it's been decades since Eastern European markets opened their borders for free trade and transitioned from a centrally-planned to a market economy, there are still considerable differences between the operation of businesses in Western and post-communist countries. The sale of assets to private hands did not ensure its effective management. Administrative functions should focus on setting targets and corresponding policies to fulfilling the interests of owners.

Currently, the most widely used system in Central Europe is the continental-European model, including the existence of three bodies: the General Meeting, the Supervisory Board and Board of Directors. This model was recently the only possible in the Czech Republic. From the above it is clear that the way how the business will prosper (ie. to achieve the desired financial performance) depends on the decisions of firm's organs that are made up of groups of people of different ages, nationalities, gender and having different ways of professional development, other education and experience. This heterogeneity in the group is called diversity. Pelled (1999) distinguishes demographic diversity (= degree to which the organization is heterogeneous with respect to demographic attributes) and functional diversity of backgrounds (= degree of heterogeneity in education and experience).

The corporate governance is rather new term, and the number of studies is rising in these days. A topic of corporate governance is very broad and consists of legal setting of the companies in a country and, in many cases, the free-will setting of a company management

and corporate governance rules. In the Czech Republic, there is no strict or mandatory script for corporate governance. When thinking of the connection between corporate governance and the performance, the numbers of scientific papers is rather low. This article is new contribution to this topic from the very actual point of view of age diversity and age in the company – effectively connecting two actual topics – corporate governance and the age management in the ageing environment of the European Union as well as an area of gender issue among board members.

The problem in the research, and this is proven in many studies setting and researching often very different factors, is to set the proper variables. Those, that influence the performance most significantly. In our paper, we have focused on the age and gender diversity among the managing and supervisory boards in the companies as bearer of the strategic management in the companies and thus one of the factors of the corporate governance. Our contribution is to research on the sample of the Czech companies, whether the age and gender diversity in the company's bodies have an effect on the key performance indicators.

Performance measurement

The word performance is widely used in all fields of business management. Nevertheless, performance as a term is not precisely explained. Dictionary explanation of the term varies and is frequently defined from the concrete point of view. One of many definitions (Neely et al., 2003), (Wholey et al., 1996) of performance is the one of Richard and Devinney (2009):

Organizational performance encompasses three specific areas of firm outcomes:

- (a) financial performance (profits, return on assets, return on investment, etc.);
- (b) product market performance (sales, market share, etc.);
- (c) shareholder return (total shareholder return, economic value added, etc.).

In the Czech Republic, the financial performance is the most suitable, as the financial data are believed to be most precise, although there are some limitations – tax policies of company etc. The product market performance is hard to observe, as we have chosen the general IT companies in the Czech Republic market and the sales or market share are not part of the financial statements, those are base of our research. Shareholder return is not usable in the Czech Republic because most of the companies in the sample are not publicly traded and there is no evidence of sharing the profit.

Financial performance of the company is usually depicted using key performance indicators. In this paper there will be consistency with most used traditional indicators mentioned by Hult (2008) ROA, ROE, ROS. In addition, there will be used liquidity ratios and indebtedness as an indicator of financial responsibility and stability.

Construction of the performance indicators is standardized, using EBIT in both ROA and ROS. For the liquidity ratio, the sum of short term liabilities with short term loans and financial aids will be used. For the indebtedness, there are two ratios, general indebtedness and the investor's risk. We will use only general indebtedness is rate of equity another sources as a measure for the stability of the company.

Table 1 Key Performance Indicators Overview

KPI	Target	Characteristics
ROA	maximization	performance
ROS	maximization	performance
Liquidity (current ratio)	Optimization towards optimum (adequate)	Carefulness approach – insurance against market risk

General indebtedness	Optimization towards optimum (adequate)	Carefulness approach – risk of control loss
----------------------	---	---

Source: own creation based on literature mentioned above

Corporate governance and performance

State or find a concrete factor, that has an important or key impact on performance of the companies is not trivial. General problem of humanities is the number of factors influencing the operations of the company. Many studies proof relation of corporate governance and the performance of the companies expressed by financial indicators. This linkage was declared specifically in Bebczuk's (2005) research of Argentinian companies and Gruszczynski's (2006) research in Poland. More generally the impact of good corporate governance is expressed in Gompers's, Ishii's and Metrick's (2003) research paper, Bhagat and Bolton's (2008) study and predominantly Milstein report of good corporate governance in general. In all studies it is declared, that the good corporate governance, regardless the meaning of adjective good, doesn't mean higher performance, but bad corporate governance means undoubtedly lower performance. In these studies, authors were using the EVA or Tobin q. In the study of Ooihi a Lecomt (2013), the principle of the stock market valuation was used. These approaches are not feasible in the Czech Republic, due to low number of companies being publicly traded on stock market – the financial data will be used instead.

Corporate governance as an operation – good managing of the company includes also taking managerial risk, decision making process and in this area predominantly targeting of the KPI in the company. This process might be influenced by the nature and the composition of management boards in the companies – the bearers of the "strategic" corporate government. In this paper we focus mainly on age and gender composition of the boards in the selected Czech companies.

Gender and Age diversity

Discussion about importance of demographic characteristics of board members is coming to the researchers' attention. A Ratio of women participating at the labour markets has been getting bigger since Second World War. So, gender diversity is not only the current topic in the management area, but also in overall society. Heidrick and Struggles (2007) proved in their report that women proportion at the European labour markets are increasing in the last years, from 5% in 2001 to 8.4% in 2007. But we are still not at the same level as American companies and big differences among European countries exist. The Scandinavian countries are widely known for their progressive approach in involving older people and women into the working process at higher positions. However, in the central-European context, gender and age diversity is out of the primal research focus of most researchers. There are some studies aiming at gender diversity, because it is easier for statistical study rather than age diversity, which is hard to define. An interest in gender diversity is also supported by European policy, which is trying to introduce women quotas for executive and supervisory bodies of companies at the level of 20%. (Matsa, Miller, 2013). Campbell (2008) provides us two reasons, why women should be included among members of companies' bodies more often. At first, there are ethical arguments. Excluding women from executive and supervisory bodies only because of gender can be considered as discrimination. And no firm wants to build up an image of low Corporate Social Responsibility. Secondly, economic arguments are related to the assumption that every company should choose for each job position the most suitable candidates, who reflected all requirements for that position. If you exclude women, your financial performance can decline, since you didn't have to choose the best candidate. So the higher diversity can bring a competitive advantage for a company.

Age diversity is getting more popular with ageing tsunami topic. According to the higher percentage of older people (above 50 years) at the labour markets, employment, inter-generation teams operation or their engagement in organizational culture is becoming interesting for researchers. Robinson (1997) presents that company's costumers are

diverse as well, so more diverse working teams can understand needs of your target groups easier. As a result you can provide more customize products and penetrate additional markets. Second, it is argued that diversity increases creativity, innovation and new approaches for problem solving. In addition, a process of knowledge creation and sharing is encouraged by members' diversity, which is extremely important in a case of original, not repeated tasks requiring high level of creativity for solving. (Van Knippenberg and Schippers, 2007). At third, it is argued that diversity can support problem-solving process as the variety of perspectives and opinions are emerging from more diverse board members bring more alternatives for evaluation. An understanding of high complex system, which undoubtedly business environment is, can improve decision making process. Decision will be right with higher probability. It may also lead to improvement of firm's image as well as benefits from customer behaviour. (Smith et al., 2006)

Based on literature overview provided in previous text, we propose these hypothesis and research questions:

- 1) Firm's performance is diminishing with increasing age among members of the company bodies.
- 2) Firm's performance is diminishing with higher ratio of women among members of the company bodies.
- 3) Firm's security is stronger with higher ratio of women among members of the company bodies.
- 4) Firm's security is stronger with higher age among members of the company bodies.

2 Methodology

Our initial sample included 364 companies with Czech domicile operating in manufacturing industry, especially in IT industry. Randomly chosen sample is composed of 71 Czech joint-stock companies from IT industry. Two of examined companies had no data in evidence, thus the final number of researched firms is 69. For this sample we gained basic data describing the number of supervisory and managing board members, their age, gender as well as current key performance indicators (ROA, ROS, liquidity, indebtedness) for selected fiscal year 2012. We have chosen this year after first data scan, in 2012 there is the highest completeness of required data. All data had to be obtained manually from public business register, since in the Czech Republic there is no central database, where everybody can download mentioned data automatically (as it is in American business environment). That's also the main reason, why we need to handle with lower sample than it is usual in American research literature.

Gender diversity is calculated as the proportion of women to the total number of members on the supervisory and managing board. Age diversity is problematic for statistic testing since there is no clearly defined way how to measure it. So, we decided to make an average age from all managing and supervisory board members for each examined company. To asses firm performance we used various Key Performance Indicators - return on assets (ROA), return on sales (ROS), current ratio (CURRAT), indebtedness (DEBT). For testing the relationship between age and gender diversity and firm performance, we used Kendall tau. All calculation were accomplished by software IBM SPSS, version 23.

3 Results and Discussion

In the table 2 we can find the basic characteristics of our research sample. Return of assets is around 7.4%, which is slightly higher than average rate in the Czech Republic. Return of sales is 6.5% that number doesn't deviate from common range. Average age among managing and supervisory boards' members is around 50. This number is lower than in German companies (Janošová et al., 2016), since German promotion system is based on senior principle, it means you build your career in one company, over time you are promoted according your experiences. Women share in Czech boards around 23 % falls into extremely high figure, typical more for Scandinavian countries rather than central European.

Table 2 Basic Sample Description

Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
ROA	69	,0743	,42572	,05125
ROS	69	,0654	,36887	,04441
CURRAT	69	22,6951	77,04534	9,27517
DEBT	69	2,9738	23,14120	2,78587
Avrage	69	50,0329	5,58147	,67193
Womenshare	69	,2309	,21710	,02614

Source: own computation

For the hypothesis testing, we have chosen the Kendall tau, which is suitable for testing of association of interval and ordinal variables. The results are provided in the table 3.

Table 3 Kendall Tau Test

		ROA	ROS	CURRAT	DEBT	Women share	Avr. age
ROA	Correlation Coefficient	1,000	,734**	0,011	0,126	0,052	0,049
	Sig. (2-tailed)		0,000	0,897	0,127	0,564	0,555
	N	69	69	69	69	69	69
ROS	Correlation Coefficient	,734**	1,000	0,008	0,125	0,087	0,000
	Sig. (2-tailed)	0,000		0,926	0,130	0,336	0,996
	N	69	69	69	69	69	69
CURRAT	Correlation Coefficient	0,011	0,008	1,000	- ,251**	,204*	-0,063
	Sig. (2-tailed)	0,897	0,926		0,002	0,023	0,446
	N	69	69	69	69	69	69
DEBT	Correlation Coefficient	0,126	0,125	-,251**	1,000	-,309**	-0,017
	Sig. (2-tailed)	0,127	0,130	0,002		0,001	0,840
	N	69	69	69	69	69	69
Women share	Correlation Coefficient	0,052	0,087	,204*	- ,309**	1,000	-0,004
	Sig. (2-tailed)	0,564	0,336	0,023	0,001		0,966
	N	69	69	69	69	69	69
Avr. age	Correlation Coefficient	0,049	0,000	-0,063	-0,017	-0,004	1,000
	Sig. (2-tailed)	0,555	0,996	0,446	0,840	0,966	
	N	69	69	69	69	69	69

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Source: own computing

Of the association, the awaited association is between ROA and ROS. These two key performance indicators are functionally connected. The same logical connection is among

the current ratio and indebtedness. When talking about the aim of the article, it must be assumed, that average age has no connection to any of observed dependent variables. The second, share of women in the bodies of the companies has significant correlation coefficient to current ratio and indebtedness, which means that higher percentage of women between board members will result in lower level of firm indebtedness. Similar score can be found for a relationship between women share and current ratio. With raising women share, current share is also heightening. Both of the key performance indicators are part of the firm security.

4 Discussion and Conclusion

Age diversity and gender diversity were studied in the way as researched by Byrnes and Miller (1999), ea. in the connection to risk-taking tendencies. The meta-analysis resulted in support of the idea, that male participants are less risky avoidant than females and the variety also fluctuated according to respondents' age. On the contrary, Bonem (2015) states, that the older people see more danger in ethical and health problems, but in the social area they can accept more risk. The social area can be connected to the decision-making process through negotiating and propagation of own opinion on problems in the company and finding solution. In our research, age diversity among the average age of the bodies' members in the Czech IT companies showed no significant results. Average age of the members was around 50 years, what might be surprised in IT sector. The question is, what is the nature of these people being in such innovative sector and if holding the position in bodies of the company means also furthering and strengthening the corporate governance principle of transparency – the owners are also managers in the company and have control.

Rolison (2003) states that "Financial risk taking reduced steeply in later life for men but not for women". As there are not direct studies of connection between managerial style and gender/age, this study can be approximation of financial risk of the company management. The older the managers are, the more conservative the managerial decision should be, unless there are women at power in the board of director.

The main purpose of this research study was to present age and gender diversity topic in connection with key performance indicators. The initial research sample comprised from Czech joint-stock companies operating in IT industry, with Czech headquarters. Average and gender diversity was chosen as a topic based on theoretical studies mentioned in literature review, which consider these types of diversity as possible factor of firm's competitive advantage. Age and gender structure was can potentially have influence on corporate performance, in case of this article measured using ROA, ROS, indebtedness and current ratio. Because we primarily proceeded from more general theories, which provide evidences about the positive effects of diverse teams (irrespective of the specific diversity type), demonstrating themselves in an increased level of innovation, creative environment and knowledge sharing, our research interest did not limit on age diversity, but also that of gender.

Our findings are restricted by the size and selectivity of research sample, which do not allow us to analyse data by more advanced statistical methods used in western literature. Most of Czech joint-stock companies are not publicly traded, so the number of possible tests is limited. Furthermore, the key performance indicators used are only some kind of the possible analysis instruments and by its very nature may be distorted by unexpected external or internal circumstances.

Within the sample of IT companies operating in the Czech Republic examined here, we can conclude that gender has significant impact on firm's indebtedness and current ration. Lower indebtedness and higher current ration contribute to better security of company, which may be a competitive advantage within crisis time, but too expensive in boom years, since that firm policy binds financial resources. Concerning age diversity, we cannot prove any significant results. So, we could not prove any bias between board members' age and key performance indicators. For future researches, it will be necessary to include other industries or pick out bigger sample from IT industry. It's also possible, that IT area

demonstrates slightly different results than other fields from manufacturing industry, because of greatly unstable and creative environment. Therefore, we should conduct research in a few areas to compare results and prove trend.

References

- Bebczuk, R. (2005). Inter-american Development Bank. Corporate governance and ownership: measurement and impact on corporate performance and dividend policies in Argentina. *Working paper*.
- Bhagat, S., Bolton, B. (2008). Corporate governance and firm performance. *Journal of Corporate Finance*, vol. 2008(14), pp. 257-273.
- Bonem, E. M., Ellsworth, P. C., Gonzalez, R. (2015). Age Differences in Risk: Perceptions, Intentions and Domains, *Journal of Behavioral Decision Making*, vol. 28(4), pp. 317-330.
- Bourne, M., Neely, A., Mills, J., Platts, K., Zairi, M., Packová, V., Karácsóny, P., Barnes, D., Hinton, M., Guerris-Lpez, I. (2003) Implementing performance measurement systems: a literature review: a literature review. *International Journal of Business Performance Management*, vol. 5(1), pp. 251-274.
- Byrnes, J. P., Miller, D. C., Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis, *Psychological bulletin*, vol. 125(3), pp. 367.
- Campbell, K., Mínguez-Vera, A. (2008). Gender Diversity in the Boardroom and Firm Financial Performance, *Journal of Business Ethics*, vol. 83(3), pp. 435-451.
- Gruszczynski, M. (2006). Corporate Governance and Financial Performance of Companies in Poland. *International Advances in Economic Research*, vol. 12(2), pp. 251-259.
- Harris, C. R., Jenkins, M., Glaser, D. (2006). Gender differences in risk assessment: why do women take fewer risks than men? *Judgment and Decision Making*, vol. 1(1), pp. 48-63.
- Heidrick, Struggles. (2007). *Corporate Governance in Europe*. Retrieved from: http://www.alpartner.ch/content/Corporate_Governance%5B1%5D.pdf
- Hult, G., Ketchen, M. D., Griffith, D., Chabowski, B., Hamman, M., Dykes, B. J., Pollite, W. A., Cavusgil, S. T. (2008). An assessment of the measurement of performance in international business research. *Journal of International Business Studies*, vol. 39(6), pp. 1064-1080.
- Janošová, L., Jirásek, M., Pirožek, P. (2016). *Diversity of Czech and German Corporate boards – experience from MNC's*. In Florina Pinzaru, Constantin Bratianu. *Proceedings of the 12th European Conference on Management Leadership and Governance (ECMLG 2016)*. UK: Academic Conferences and Publishing International Limited, pp. 109-116.
- Matsa, D. A., Miller, A. R. (2013). A Female Style in Corporate Leadership? Evidence from Quotas. *American Economic Journal: Applied Economics*, vol. 5(3), pp. 136-169.
- Lecomte, P., Ooi, J. T. L. (2013). Corporate Governance and Performance of Externally Managed Singapore Reits. *The Journal of Real Estate Finance and Economics*, vol. 46(4), pp. 664-684.
- Pelled, L. H., Eisenhardt, K. M., Xin, K. R. (1999). Exploring the black box: An analysis of work group diversity, conflict and performance. *Administrative science quarterly*, vol. 44(1), pp. 1-28.
- Richard, P. J., T. M. Devinney, G. S. Yip, Johnson, G. (2009). Measuring Organizational Performance: Towards Methodological Best Practice. *Journal of Management*, vol. 35(3), pp. 718-804.
- Robinson, G., Dechant, K. (1997). Building a Business Case for Diversity. *Academy of Management Executive*, vol. 11(3), pp. 21-30.

Rolison, J., Hanoch, Y, Wood, S., Liu, P.J. (2014). Risk-taking differences across the adult life span: a question of age and domain. *The Journals Of Gerontology. Series B, Psychological Sciences And Social Sciences*, vol. 69(6), pp. 870-80.

Smith, N., V. Smith, Verner, M. (2006). Do Women in Top Management Affect Firm Performance? A Panel Study of 2,500 Danish Firms. *International Journal of Productivity and Performance Management*, vol. 55(7), pp. 569–593.

Van Knippenberg, D., Schippers, M. C. (2007). Work group diversity. *Annual Review of Psychology*, vol. 58, pp. 515-541.

Wholey, J. S. (1996). Formative and summative evaluation: Related issues in performance measurement. *Evaluation Practice*, vol. 17(2), pp. 145-149.

The Influence of Government Support on the Crop Insurance Uptake

Monika Kaczała

Poznań University of Economics and Business
Department of Insurance
Al. Niepodległości 10, 61-875 Poznań, Poland
E-mail: m.kaczala@ue.poznan.pl

Abstract: *Rationales for government intervention in agricultural insurance market are widely approved. The main aim of this study is to identify the relationship between the crop insurance uptake and different government intervention on the Polish market. The local legislation restrictions as well as data available have been analyzed. The measure of crop insurance uptake was the amount of insured arable land. The most important instruments identified are: insurance obligation, premium subsidies and the possibility of insuring crops against a single risk (abolition of risk packages).*

Keywords: *crop insurance, subsidies, demand, state intervention, Poland*

JEL codes: *Q14, R28, G22, H76, K12*

1 Introduction

Agricultural insurance dates back several hundred years. In Europe it started as early as the end of the 17th century, when mutual insurance against hail was introduced; in the 19th century it was offered in several European countries and in the USA (Mahul and Stutley, 2010). In the past few decades, development of this type of insurance measured according to the volume of gross written premium and the range and scope of insurance products has intensified, which is connected with growing state activity in this market sector (Smith and Glauber, 2012).

In the USA the first state-subsidised crop insurance scheme was implemented in 1938. In the following years it was modified, which resulted in the growing commitment of the state (Goodwin and Smith, 2013). In 1939 governments introduced subsidised crop insurance in Japan and Brazil, in 1943 in Jamaica (UNCTAD 1994), and in 1959 in Canada. European countries began running similar programmes as of the 50's, e.g. in Austria in 1955, in Italy in 1970, in Spain in 1980 and in France as late as 2005 (from 1965 France ran a state-sponsored insurance programme called the National Guarantee Fund for Farming Calamities (FNGCA)), and in Poland in 2006 (Enjolras, Capitanio, and Adinolfi, 2012; Enjolras and Sentis, 2011; Kaczała and Wiśniewska, 2015; Mahul and Stutley, 2010; OECD, 2011).

The subject literature points at the three types of reasons for government intervention with regard to agricultural insurance, i.e. market failures, disparity in the availability of private insurance between regions and crops and reporting damage more promptly. Market failures result from three phenomena, generally present in the insurance market and in agricultural insurance in particular: moral hazard (Coble et al., 1997), Goodwin, 2001), adverse selection problems (Skees and Reed, 1986; Just, Calvin, and Quiggin, 1999) and systemic risk (Kleindorfer and Klein, 2003).

State intervention in the crop insurance market may take various forms, i.e. premium subsidy, reinsurance backing for insurance companies, covering administrative or operating costs or providing support with reference to infrastructure needed for data collection connected with risk assessment. Several forms of support are likely to be used simultaneously within the framework of the same programme. WTO guidelines determine acceptability of a given form of intervention, along with CAP regulations for the EU members as well as local legislations.

The main aim of this study is to identify the relationship between the crop insurance uptake and various forms of government intervention on the Polish market.

2 Methodology and Data

To solve the problem, a legal and functional point of view will be applied. In order to identify intervention mechanisms one must analyse local legislation as well as superior regulations (WTO and the EU). Due to the fact that both of these superior regulations are well known and described in the subject literature, and Poland has been obliged, since its accession to the European Union, to conform to the legal regulations in force in the EU, and the EU members must comply with standards set by the WTO as for state intervention on the agricultural market – the present analysis focuses on local regulations. The description is complete with the analysis of the available data, which has been obtained from the Ministry of Agriculture and Rural Development (MARD), the Central Statistical Office of Poland (GUS) and state budget implementation reports. Application of advanced methods of statistical analysis is quite limited, due to a brief period of analysis determined by data accessibility and a high level of data aggregation. Auxiliary calculations have been conducted by means of Excel and Gretl. The measure of crop insurance uptake is the amount of insured arable land.

3 Results and Discussion - Main instruments of government support on the agricultural insurance market in Poland

Historical overview until 2005

State intervention has been seen on the agricultural insurance market for a very long time. It had two forms: establishing or very tight control of insurance companies which would offer this type of insurance and introduction of obligatory insurance.

The beginnings of the agricultural quasi-insurance funds in the form of brotherhoods date back to the 17th century, when representatives of several villages located on the island between the rivers of Vistula and Nogat along with people from towns near Elbląg and Gdansk, set up a brotherhood which guaranteed a payment of cash as a compensation for flood or fire depending on the amount of cultivated farmland (Szczęśniak, 2006). During the partitions period, i.e. from 1772 to 1918, three independent insurance systems were established, in the Prussian, Russian and Austrian partition respectively. Agricultural insurance was offered in each, at different time and in various scopes, and all of them were tightly controlled by the respective state authorities. Hence, in the Prussian partition in 1785 the Kwidzyń Society introduced obligatory insurance against fire which encompassed rural property (only the property of the gentry was exempt from it); in 1790 a Gentry and Landowners' Fire Society was founded, in 1804 a fire society for villages in South Prussia, followed by further establishments in Prussia (Szczęśniak, 2006a). Starting from 1873 it was possible to insure crops, and obligatory insurance against hail became available in the beginning of the 20th century. During the period of the Duchy of Warsaw (1807-1815) the Prussian organisations were dismissed and in 1807 the Fire Society for Towns and Villages came into being, introducing obligatory insurance against fire for villages (gentry property was exempt) (Szczęśniak, 2006b).

In the Kingdom of Poland (also known as Congress Poland, being the Russian partition from 1815) the above society was closed down and replaced by a new one, which imposed the duty of insuring all land property against fire (except for inherited property) and in 1833 it was made possible (through another society) to insure farming machines, loss of shipped goods, mill and oil press machinery, crops and farm animals. In 1843 the insured risks also included hail and cattle plague (Szczęśniak, 2008). In the Austrian partition insurance against fire existed from 1860, against hail from 1864 and cattle plague was first insured in 1906 (Szczęśniak, 2009).

When Poland regained independence (1918), in 1921 obligatory insurance against fire was introduced for farm buildings, and starting from 1929 in particular voivodships it was possible to insure crops against hail and animals against plague. (Stroiński, 1989).

After the Second World War and the change in the economic system it was assumed as a rule that the whole farm property should be insured. Gradually, from 1947, obligatory crop

insurance was introduced for rye, barley, wheat and oats, and with time the scope encompassing crops was broadened to include maize, potatoes, buckwheat, fodder plants, meadows and pastures. Insurance against hail and flood was obligatory (from 1972) although voluntary insurance also covered damage done by spring frost, winterkill, hurricane or drought (only in 1957-58). The terms of crop insurance assumed full cover of the loss, considering a 10% integrated deductible. Later, if the crop was entirely damaged in the early stages of growth, the level of loss was established according to the level of insurance amount. Apart from crops, the farmer also had an obligation to insure buildings against fire, movable property (livestock and inventory, household movables, reserves) and farm animals against plague. In the 1970's obligatory third-party liability insurance for farm owners was introduced, which transfers onto the insurance company financial liability for unintentional damage caused by the farmer while performing vocational activities. Obligatory insurance types (eventually, there were nine) were contractless, (concluded by *ex lege*) and the premium was included in the tax. Until 1984 the obligation only encompassed private farms with the farmland exceeding 0.5 ha, (which was an important exclusion, as PGR-s (state-owned collective farms) accounted for 10% of the land in 1950 and 20% in 1989). After 1984 the scope of obligatory crop insurance shrunk, as industrial, seed and horticultural plants were excluded from the obligation, and were covered by voluntary insurance. From that year, too, as a result of legal changes which allowed more insurance companies to be set up in Poland, the number of entities offering agricultural insurance grew from one to three.

After the collapse of communism in 1989 obligatory agricultural insurance was abolished, all except two types: firstly, insurance of farm buildings against fire or any other random incidents which oblige the insurance company to cover the costs of rebuilding or refurbishment of the damaged premises and secondly, third-party liability insurance for farmers. Therefore, the number of crop and animal insurance contracts fell dramatically (table 1).

Table 1 Number of Insurance Contracts Before and After the System Transformation

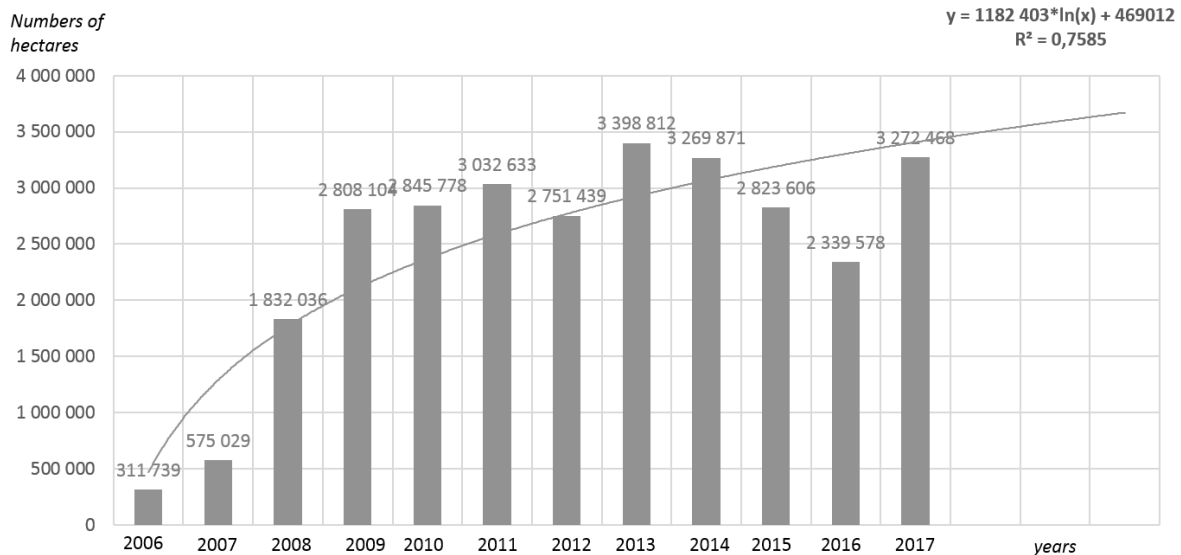
Years	Insurance of farm buildings (thousands)	Property insurance (thousands)	Crop insurance (thousands)	Livestock insurance (thousands)
1985	3 098	3 098	3 098	20 273
1986	2 966	2 966	2 966	22 936
1987	2 901	2 901	2 901	21 139
1988	2 886	2 886	2 886	22 155
1997	1 486	354	75	202
1998	1 449	373	61	187
2001	1 357	393	45	98

Source: Rojewski 2012

The period from 2006 to 2017

Introduction in September 2005 of the act on subsidised crop and animal insurance under the rule of which sales started in 2006, made it possible to initiate several government intervention instruments on the market, such as: premium subsidies (level of subsidy, maximum tariff levels which entitle farmers to a subsidy) introduction of obligatory crop insurance, a possibility to insure crops against one risk or a whole package of risks, defining the subjective scope of subsidised insurance (type of crop), defining the entities eligible for a subsidy, defining the maximum insurance amount, subsidies for insurance companies in the case of excessive damage caused by drought and support for drought monitoring in Poland. All of these actions have significantly increased the scope of insurance cover. Initially, only 3% of all crops were covered by subsidised insurance, while eleven years later it was as much as 31% (data from Ministry of Agriculture and Rural Development).

Figure 1 Amount of Farmland Covered by Subsidised Crop Insurance in 2006-2017



Source: MARD and CSO data for the years 2006-2017

Firstly, subsidies were offered with reference to premiums paid by the farmer for one policy annually. Over the first three seasons, i.e. until 3 June 2007 subsidies amounted to 40% for cereals, maize, rapeseed, turnip rape, potatoes, and sugar beets and 35% for potatoes or sugar beets; next, until 2016 it was 50% for all insured crops, and from 2016 onward 65% for all crops. Subsidy was allocated on condition that the tariff did not exceed the established limit. In this way a limit was set for the price which entitled the farmers to the subsidy. It was connected with limiting the state budget spending as well as prevented insurance companies from raising the prices because of the subsidies. In 2006 the upper limit of tariff accounted for 3.5% of the insurance amount, and if it should be exceeded, the subsidy was not granted. From April 2007 the limit was raised to 5% of the insurance amount for certain crops, such as winter rapeseed, outdoor grown vegetables, hops, tobacco, fruit trees and shrubs, strawberries or legumes, while for other crops (cereals, maize, spring rapeseed, turnip rape, potatoes or sugar beets) it remained at 3.5%. If a farmer exceeded the maximum tariff by less than 1 percentage point, they received a subsidy up to the maximum tariff, and if it was more than 6% of the insurance amount, they received no subsidy at all. This regulation was abolished in July 2015 for outdoor vegetables and fruit trees and shrubs. In 2017 new maximum tariffs were introduced - 9% of the insurance amount, and in the case of crops grown on poor quality soils 12% (class 5) or 15% (class 6). Initially, exceeding this limit caused the subsidy to be withdrawn. Four months later, however (i.e. before the spring season began) the regulation was changed. When the tariffs were exceeded, (calculated both for the whole package of ten possible risks and for the collective tariffs for selected risks) subsidies were reduced according to the percentage of tariff increase, with exclusion of tariffs for drought and winterkill. The above rule was slightly modified for fruit trees, shrubs and strawberries, in the case of which exceeding of the tariff entailed a subsidy according to maximum rates. The correlation between the insured area and the average amount of subsidy (in percentage) is moderately positive ($r\text{-pearson}=0.57$, $p\text{-value}=0.025$).

It is not statistically relevant ($p\text{-value} > 0.1$) for cereals, rapeseed, fruit trees and shrubs, tobacco, strawberries and hops. It is moderately positive for maize ($r\text{-pearson}=0.62$, $p\text{-value}=0.03$), legumes ($r\text{-pearson}=0.66$, $p\text{-value}=0.03$), outdoor vegetables ($r\text{-pearson}=0.61$, $p\text{-value}=0.04$) and it is strong and positive for sugar beets ($r\text{-pearson}=0.75$, $p\text{-value}=0.01$). The correlation between the insured area and the average maximum tariff is weak and positive ($r\text{-pearson}=0.40$, $p\text{-value}=0.1$). It is statistically relevant and rather positive for maize ($r\text{-pearson}=0.52$, $p\text{-value}=0.06$), sugar beets ($r\text{-pearson}=0.57$, $p\text{-value}=0.025$).

pearson=0.65, p-value=0.02), legumes (r-pearson=0.61, p-value=0.04), and outdoor vegetables (r-pearson=0.61, p-value=0.04).

The value of annual premium subsidies and average subsidy per 1 ha can be seen in table 2. Although since 2011 premium subsidies have exceeded the planned annual limits, it was only in 2016 that sales were reduced significantly due to lack of financing from the budget (the subsidy pool dried out virtually a few days after the beginning of the autumn season as a result of increase in tariffs after the experiences connected with 2015 winterkill). This justifies the lack of correlation between the volume of planned subsidies and the insured area (p-value=0.15). The level of actual subsidies is in turn moderately positively correlated with the size of the insured area (r-pearson=0.67, p-value=0.01). A statistically relevant, positive and moderate correlation can be observed for cereals (r-pearson=0.48, p-value=0.08), maize (r-pearson=0.64, p-value=0.02), rapeseed (r-pearson=0.58, p-value=0.04), legumes (r-pearson=0.54, p-value=0.07), outdoor vegetables (r-pearson=0.56, p-value=0.06), and a very strong one for sugar beets (r-pearson=0.75, p-value=0.01).

Table 2 State Budget Subsidy for Crop and Animal Insurance System

	Crop and animal insurance subsidies (millions of PLN)		Average subsidy per 1 ha (PLN)	Subsidies for insurance companies for excessive damage caused by drought (millions of PLN)	
	actual	planned		actual	planned
2006	9,861	55	31,6	-	-
2007	39,348	59,902	68,4	209,902	210
2008	97,596	168,472	53,3	545	545
2009	131,139	150	46,7	150	150
2010	96,679	108,47	34,0	193,147	300
2011	126,141	100	41,6	100	100
2012	162,412	103,8	59,0	68,641	100
2013	164,407	103,8	48,4	80	80
2014	161,363	100,717	49,3	99,5	100
2015	173,177	100,717	61,3	100	100
2016	207,03	100,717	88,5	100	100
2017	397,9	725	121,6	n.d.	100

Source: Budget implementation report for the years 2006-2017

The connection between the volume of subsidies and the amount of insured arable land is clear and dependent on the subsidy level.

Another instrument was the introduction of obligatory insurance for farmers who had obtained direct subsidies for arable land in the previous year. The obligation refers at least to half of the area sown with crops which can be covered by state-subsidised insurance and must apply to at least one of the five occurrences: drought, flood, hail, winterkill or spring frost. Introduction of this requirement was directly enforced by the European Commission decree (1857/2009) which pointed at the connection between meeting the insurance requirement and the possible ad hoc assistance offered by the state. This instrument, although initially intended for a different purpose, appeared to be very effective in boosting popularity of crop insurance. Considering that there were no other relevant changes in the regulations at that time, introduction of obligatory insurance can be treated as the main cause of more than twofold growth in the amount of insured land. It must be stated, though, that farmers fulfilled this new obligation by purchasing insurance against the cheapest type of risk, namely hail.

The element which exerts an immediate influence on the price of crop insurance and, in presence of maximum tariffs, on accessibility and level of subsidies, is the possibility of insuring against single risks. Initially, subsidised crop insurance encompassed whole packages of risks, such as: hurricane, flood, torrential rain, hail, lightning, landslide, avalanche, drought, winterkill and spring frost (at the very start, during the first season, the list also included fire and explosion). In April 2007, however, a choice of a single risk to be insured against was enabled. Also, several times during the term of the act being in force definitions of some occurrences (drought, spring frost and winterkill, among others) were altered. This certainly resulted in an increase in access to insurance, although one has to remember that the 84%-growth in crop-insured area was also connected with the rise in the level of premium subsidy.

A few times, especially at the start of the subsidy system, the range of crops which could be subsidised, was broadened. Initially, subsidies were granted for insurance of cereals, maize, rapeseed, turnip rape, potatoes, or sugar beets i.e. essential/basic crops. From the beginning of 2007 subsidised insurance could be used for hops, vegetables, fruit trees and shrubs and in April 2007 the list was complemented with tobacco, strawberries and legumes. Nevertheless, broadening the range of crops did not contribute to increasing the amount of insured land. The six initial crops accounted for at least 95% of the insured area throughout the analysed period. It must be said, however, that the structure of the insured crops changed despite the stable structure of sown plants. For instance, in 2006 the area of insured rapeseed made up 60% of the whole insured land, while in the years 2009-2017 30% on the average (MARD, 2006-2017). The drop in this crop insurance is particularly visible in 2015-16, when the winter package tariffs grew significantly. Cereals, despite the initial 39%, constituted an average 56% from 2009 to 2017.

Obtaining a crop insurance subsidy depends on assuming the insurance amount which does not exceed the maximum insurance amount per 1 hectare of a given crop which is regulated annually by the appropriate minister of agriculture. Maximum insurance amounts, which depend on the changes in market prices of a given crop (in the case of fruit trees and shrubs it is connected with the increase in the value of plantings) were introduced from 2008 and underwent changes in the analysed time period of up to 100%, the average change referring to a given crop from 3% to 17% (respective decrees by the MARD, 2007-2017). Their introduction was supposed to prevent overestimating insurance amounts by insurance companies. Reaching this goal, however, affected adversely the size of the insured area for cereals ($r\text{-pearson}=-0.5$, $p\text{-value}=0.07$) and maize ($r\text{-pearson}=-0.6$, $p\text{-value}=0.03$), which can be understood in the context of subsidy limits set for insurance companies. Interestingly, an increase in maximum insurance amount turned out to be very strongly correlated for legumes ($r\text{-pearson}=0.94$, $p\text{-value}=0.00$). This has probably allowed in the recent years to adapt the insurance amount to the actual market value of a given crop and thus has made this insurance more attractive.

The state has also defined the subjective scope of subsidy beneficiaries – initially the eligible farms were larger than 1 ha. However, in April 2007 this regulation changes and subsidies were available only up to 300 ha belonging to one agricultural producer. The regulation was abolished in August 2008. The definition of an agricultural producer was also changed several times. In April 2007 the subsidy was limited to entities which maintained the status of a small or medium-sized enterprise² which excluded from the subsidy system a whole range of enterprises, including strategic ones (e.g. owned by the Agency of Rural Property). Finally, after negotiations with the European Commission, starting from July 2015 larger farms were also admitted into the system, after they had met certain requirements. The impact of the above changes on the amount of the insured area is difficult to assess due to the lack of available data on the structure of the insured entities.

² As understood in the attachment I to the Commission decree (EU) 70/2001 of 12 January 2001 r. on application of art. 87 and 88 EU Treaty with reference to government aid for SME (Dz.Urz. WE L 10 z 13.01.2001, p. 33, with amendments.; Dz.Urz. UE Polskie wydanie specjalne, ch. 8, vol. 2, p. 141).

We also have to remember that the state can affect the supply side of the market. The only insurance companies which are allowed to offer subsidised insurance are the ones which have signed an agreement with the appropriate minister of agriculture and who meet statutory requirements. In reality, this tool did not serve as a means to limit the number of entities. When subsidised insurance was introduced onto the Polish market, there were only three insurance companies offering crop insurance and they all were admitted into the system. In the 2011/2012 season another insurer offered crop insurance, but it soon abandoned the market. In 2017 the number of companies grew to five entities. The small number of insurance companies involved constitutes a serious problem in subsidised insurance development.

Another instrument used by the state is a specific subsidy for insurance companies in the case of excessive damage caused by drought (table 1). The subsidy amounts to 60% of the difference between the total sum of compensation paid within a single calendar year for damage caused by drought and the amount which accounts for 90% of the total premiums paid in a single calendar year with respect to compulsory or subsidised crop insurance contracts (calculated in total with the subsidy). The solution, which was intended to encourage insurance companies to cover the risk of drought after risk "packages" had been abolished, came to nothing. In fact, there is no data referring to the amount of land insured against drought, but it may suffice to look at the figure concerning the number of signed insurance policies which include this risk. It decreased systematically from over 13.5 K in 2006 to a meagre 90 contracts in 2015 (the most recent available data from the Ministry of Agriculture and Rural Development, justification of the bill, 2015).

4 Conclusions

Intervention instruments applied on the agricultural insurance market come in a large variety: premium subsidies (level of subsidy, maximum tariff levels which entitle farmers to a subsidy) obligatoriness of crop insurance, a possibility to insure crops against a single risk or a whole package of risks, defining the objective scope of subsidised insurance (type of crop), defining the entities eligible for a subsidy, defining the maximum insurance amount, subsidies for insurance companies in the case of excessive damage caused by drought and support for drought monitoring in Poland.

Until 1989 the only explicitly used instrument was obligatory insurance. Nonetheless, we must not forget that the whole insurance system at that time was financed, managed and controlled by the state. Obligation was reintroduced in 2008, after approximately 15 years, under completely different market conditions. This clearly affected the amount of insured land, albeit well below the expected levels. This is due to the relatively weak sanctions which usually were not executed.

After the introduction of premium subsidies, i.e. from 2006, a systematic growth in the amount of insured land could be seen, although the correlation between these figures is rather moderate ($r\text{-pearson}=0.67$, $p\text{-value}=0.01$). Importance of the subsidy level in the context of increasing the amount of insured land was contingent on the type of crop. It mostly affected insurance of sugar beet sowings, and, to a slightly smaller extent, maize, legumes and outdoor vegetables. For the same crops, raising the upper premium limits, which were not exceeded, also had a stimulating effect.

The possibility of insuring crops against a single risk (abolition of risk packages) was at least partly responsible for the 84%-growth of insured area in 2007. Unfortunately, precise assessment of this influence is impossible due to lack of data. For the same reasons, it is also difficult to calculate the implications of admission of large enterprises into the system of subsidies. However, it is possible to state that increasing the objective scope of subsidised insurance (the types of insurable crops) resulted in only a slight increase in the amount of insured sowings.

The maximum level of insurance amounts, regulated by the government was relevant to the amount of insured cereal, maize, and legume sown land; in the first two cases it had a de-stimulating effect, while in the latter one it increased the insurance levels. One may

presume, however, that the negative correlation in the case of cereals and maize may become more feeble in the near future because the premium subsidy levels have been raised a few times; hence, accepting larger insurance amounts will not have to imply limiting the amount of insured land.

The specific subsidy for insurance companies which has been aimed at covering excessive costs of drought impact, and thus was to encourage insurance companies to offer cover for this risk turned out to be a complete failure.

The above analysis of the efficiency of government intervention instruments on the insurance market should be extended – as the next step – to encompass the effectiveness analysis. Such an analysis would look at the aspects (effectiveness for whom?), and would call for identification of the purpose of using certain instruments (what for?). One of such aims is, as one can suppose, the problem analyzed here, i.e. the extent of crop insurance which could achieve an assumed level (how high and why this high?). Such considerations on effectiveness would also have to refer to the fact that application of the presented instruments may lead to (and indeed it does) a different impact than the intended one and in various areas (sowings structure, environmental impact, capacity to reestablish production potential etc.).

References

- Central Statistic Office (2006-2017). *Rocznik statystyczny rolnictwa*. Retrieved from: <http://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/roczniki-statystyczne/rocznik-statystyczny-rolnictwa-2017,6,11.html>.
- Coble, K. H., T. O. Knight, R. D. Pope, Williams, J. R. (1997). An Expected-Indemnity Approach to the Measurement of Moral Hazard in Crop Insurance. *American Journal of Agricultural Economics*, vol. 79(1), pp. 216–26.
- Enjolras, G., Capitanio, F., Adinolfi, F. (2012). The Demand for Crop Insurance: Combined Approaches for France and Italy. *Agricultural Economics Review* 13(1), pp. 5-22.
- Enjolras, G, Sentis, P. (2011). Crop Insurance Policies and Purchases in France. *Agricultural Economics*, vol. 42, pp. 475–486.
- Goodwin, B. K. (2001). Problems with Market Insurance in Agriculture. *American Journal of Agricultural Economics*, vol. 83(3), pp. 643–649.
- Goodwin, B. K, Smith, V. (2013). What Harm Is Done by Subsidizing Crop Insurance?. *American Journal of Agricultural Economics*, vol. 95(2), pp. 489–497.
- Just, R. E, Calvin, L., Quiggin, J. (1999). Adverse Selection in Crop Insurance: Actuarial and Asymmetric Information Incentives. *American Journal of Agricultural Economics*, vol. 81(4), pp. 834–49.
- Kaczała, M., Wiśniewska, D. (2015). Risks in the Farms in Poland and Their Financing – Research Findings. *Research Papers of Wrocław University of Economics (Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu)*, (381), pp. 98–114.
- Kleindorfer, P. R., Klein, R. W. (2003). Regulation and Markets for Catastrophe Insurance. *Advances in Economic Design*, Berlin, Heidelberg: Springer, pp. 263-279.
- Mahul, O., Stutley, Ch. (2010). *Government Support to Agricultural Insurance: Challenges and Options for Developing Countries*. Washington, DC: World Bank Publications.
- MARD, the Ministry of Agriculture and Rural Development - data regarding crop insurance.
- Ministry of Finance (2006-2017). *Budget implementation report for the years 2006-2017*. Retrieved from: <https://www.mf.gov.pl/ministerstwo-finansow/dzialalnosc/finanse-publiczne/budzet-panstwa/wykonanie-budzetu-panstwa/sprawozdanie-z-wykonania-budzetu-panstwa-roczne>.
- OECD (2011). *Managing Risk in Agriculture: Policy Assessment and Design*. OECD Publishing.

Rojewski, K. (2012). *The history and current state of agricultural insurance in Poland, Trends in agricultural insurance in Europe. Drought insurance in Poland*. Warsaw: Conference of the Polish Insurance Association, 5th Nov 2012.

Sejm of the Republic of Poland (2015). *Justification to Draft Law Amending the Act on Subsidies to Insurance of Agricultural Crops and Farm Animals*. Paper No. 3247.

Skees, J. R., Reed, M. R. (1986). Rate making for farm-level crop insurance: Implications for adverse selection. *American Journal of Agricultural Economics*, vol. 68(3), pp. 653-659.

Smith, V. H., Glauber, J. W. (2012). Agricultural Insurance in Developed Countries: Where Have We Been and Where Are We Going?. *Applied Economic Perspectives and Policy*, vol. 34(3), pp. 363-390.

Stroinski, E. (1989), *Ubezpieczenie gospodarcze jako czynnik bezpiecznego kierowania gospodarstwem rolnym*. Warszawa: Wydawnictwo Prawnicze.

Szczęśniak, M. (2006). Kasy brackie i ogniowe, banki pobożnych i karbony – to korzenie ubezpieczeń. *Monitor Ubezpieczeniowy*, vol. 26, pp. 32-34

Szczęśniak, M. (2006a). Ubezpieczenia publiczne pod zaborem pruskim w świetle prawdy historycznej. *Monitor Ubezpieczeniowy*, vol. 27, pp. 20-22.

Szczęśniak, M. (2006b). Ubezpieczenia w Księstwie Warszawskim. *Monitor Ubezpieczeniowy*, vol. 32, pp. 37-38.

Szczęśniak, M. (2008). Ubezpieczenia polskie w zaborze rosyjskim. *Monitor Ubezpieczeniowy*, vol. 35, pp. 33-34.

Szczęśniak, M. (2009). *Ubezpieczenia na ziemiach polskich pod zaborem austriackim*. *Monitor Ubezpieczeniowy*, vol. 40, pp. 37-38.

UNCTAD (1994). *Agricultural Insurance in Developing Countries: Study by the UNCTAD*. Secretariat (UNCTAD/SDD/INS/1/Rev.1), United Nations publication.

Structural Evaluation of Securities' Rates of Return in Selected Business Sectors on New York Stock Exchange

Marcin Kalinowski¹, Grzegorz Krzykowski²

¹ WSB University in Gdansk
Finance and Management Faculty, Finance Department
Grunwaldzka 238A, 80-180 Gdansk, Poland
E-mail: mkalinowski@wsb.gda.pl

² WSB University in Gdansk
Finance and Management Faculty, Finance Department
Grunwaldzka 238A, 80-180 Gdansk, Poland
E-mail: gkrzykowski@wsb.gda.pl

Abstract: *The share prices behaviour on the financial market is subject of numerous researches. Technical and fundamental analyses as well as theory of behavioural finance are attempting to demonstrate certain patterns in the share price behaviour of enterprises quoted on the stock exchange. The aim of this work is to evaluate the behavioural heterogeneity of rates of return on shares in selected sectors in the American market (NYSE). The research hypothesis of this work is the claim that share price behaviour, and rates of return on shares are sectors specific rather than global share market specific. Therefore, it is vital that we should conduct the analysis of the homogeneity of rates of return on shares of enterprises from diverse industries. The research is based on an enterprises representing four selected sectors from the American market (energy, trade, finance, health) has been instrumental in pursuing that goal. Detailed analyses have been conducted with the use of data mining methodology. The work has demonstrated the existence of behavioural heterogeneity of rates of return on shares in selected industries. The future research in this domain ought to concentrate on conducting a thorough analysis of homogeneity structure in selected industries so as to determine some regularities in the behaviour share prices in the particular industries.).*

Keywords: rate of return, market behaviour, stock market, NYSE

JEL codes: G100, G140, G150, G170, G190

1 Introduction

The behaviour of share prices on the market is subject to continual research. Technical and fundamental analyses as well as theory of behavioural finance are attempting to demonstrate certain patterns in the share price behaviour of enterprises quoted on the stock exchange.

Diverse models of functioning of the market endowed with a forecast potential are the outcome of such analyses.

The aim of this work is to evaluate the behavioural heterogeneity of rates of return on shares in selected sectors (industries) in the American market (NYSE).

The research hypothesis of this work is the claim that share price behaviour, and rates of return on shares are industry specific rather than global share market specific. Therefore, it is vital that we should conduct the analysis of the homogeneity of rates of return on shares of enterprises from diverse industries.

The research into enterprises representing four selected industries from the American market (energy, trade, finance, health) has been instrumental in pursuing that goal. Synthetic price indexes for particular sectors and representative enterprises have been created so as to carry out reliable research. Detailed analyses have been conducted with the use of data mining methodology.

The problem of functioning of financial markets is the subject of continuous research in economic sciences. Numerous theoretical and empirical studies tend to explain the

operation mechanisms on the markets, their place in the global market, the determinants of development at national and international level. Numerous theoretical models describing the functioning of financial markets are formulated. A special place in economics occupies classical financial theory, which assumes the rationality of investors in making investment decisions. Investors - according to this theory - make decisions that maximize their benefits, provided the information is properly interpreted.

Investors' investment decisions are inseparable connected with exposure to risk. Determining investor preferences and evaluating investment options are the starting point for any traditional equity valuation model.

The risk problem occurs in portfolio theory. It has become one of the basic theories of making rational investment decisions in the stock market under uncertainty. The decisions are made there due to two criteria: income and risk. H. Markowitz, Nobel Laureate is the creator of classic portfolio theory. He presented his concept for the first time in 1952 (Markowitz, 1952). The market where investors use Markowitz's portfolio theory as a tool for selecting an investment is described by the Capital Asset Pricing Model (CAPM). It is a continuation of Markovitz's theory. The CAPM model can be considered as a valuation model as it determines what is the level of return rate on the sustainable market. The CAPM theory was created in the mid-1960s. Its creators were: W. Sharpe (Sharpe, 1964), J. Lintner (Lintner, 1965), J. Mossin (Mossin, 1966) and J. Treynor (Treynor, 1961). W. Sharpe, for the CAPM was awarded the Nobel Prize in Economics in 1990. The Capital Asset Pricing Model was repeatedly criticized because it is impossible to identify in reality the market portfolio underlying the CAPM model (Fama, French, 1992), (Fama, French, 1996), (Roll, 1973). As a consequence, CAPM modifications and new pricing models for financial instruments using different valuation principles were introduced in subsequent years. An example of a capital market model that differs from the CAPM model is the Arbitrage Pricing Theory (APT). This pricing model was announced in 1976 by S. Ross (Ross, 1976). The APT model assumes the existence of law of one price on the financial markets and thus the functioning of the arbitration mechanism.

The different reasons for price changes on the stock market is described in the financial markets information efficiency theory. The determinant of investor behavior in the financial market is, according to this theory, information. The beginning of efficient market theory can be seen in 1965, when P. Samuelson argued that stock price volatility was unpredictable when all market participants had full access to information and where the information was reflected in prices (Samuelson, 1965). However, the creator of the market efficiency theory in the modern form is E. Fama. According to this author, an efficient market is a market where prices always fully reflect the information available (Fama, 1970). Market information efficiency is an important element in evaluating these markets. It allows, by analyzing price behaviour, to evaluate the behaviour of investors in stock markets. It also makes it possible to assess the adequacy of valuation of shares on the market based on fundamental data.

2 Methodology and Data

The subject of the analysis are daily share prices at closing in the group of companies of the industry under consideration. Four sectors have been selected for the analysis: energy, trade, financial and health. Four companies have been selected in every industry. The energy industry is represented by Exxon Mobil Corporation (XOM), General Electric Company (GE), Chevron Corporation (CVX), Petro China Company Limited (PTR). From the trade industry Anheuser-Busch Inber (BUD), Coca-Cola Company (KO), Pepsico (PEP), Phillip Morris International Inc. (PM), has been selected. Financial industry is represented by JP Morgan Chase & Co. (JPM), Wells Fargo & Company (WFC), Bank of America Corporation (BAC), HSBC Holdings (HSBC) and the health industry by Johnson & Johnson (JNJ), Pfizer Inc. (PFE), Novartis (NVS), Merck & Company (MRK). The data comes from NYSE in the period from 2005-02-25 to 2016-11-02. The quotes for the two companies commenced at a later period. PM is quoted from 2008-03-17 and BUD from 2009-07-01. Within this period, 2944 of daily quotes were obtained for the 16 analyzed companies. As

share prices are too diversified in terms of nominal value, the research has been based on return rates expressed in per cent

$$R_{k+1} = \frac{Price_{k+1} - Price_k}{Price_{k+1}} 100, \quad k = 0, 1, \dots, 2943. \quad (1)$$

The construction of the scaled return rate within the group of companies in the industry

The scaled return rate for the industry is based on the return rates for the selected companies within the industry and has the form of a weighted value of the rates. For the needs of this article this indicator will be called industry index (I2). The analytical form of the indicator of the daily combined return rate for the industry (I2) is as follows:

$$\sum_{i=0}^p \alpha_i R^{(i)} \quad (2)$$

where p is the number of companies in the industry, $R^{(i)}$ is the return rate for the index i ($i = 1, \dots, p$) at the specific day and the coefficients α are nonnegative and sum to unity. In case of the analyzed industries the number of companies in every industry amounts to four, thus always $p = 4$. If for example we assume equal weights (i.e. $\alpha_i = \frac{1}{4}$ for $i = 1, 2, 3, 4$), then the weighted index will be the mean value of return rates for the industry. The weights may be selected arbitrarily but usually are conditioned by the importance of the industry itself and additionally by the structure delineating the significance of each and every of the companies for the industry. The industry index, which is one-dimension transformation of the return rates in the industry, should be independent of the impact of those factors and take into consideration solely the internal structure of the return rates. In the analyses presented, the index construction for the industry should consider the long observation period and should be comparable across the industries. The proposed procedure of construction for the scaled return rate is based on the assumption that the distance measure between the daily return rates for the companies in the industry fits their one-dimensional counterparts.

It is assumed that each daily observations of return rates in the industry is the p dimensional vector. The data is presented in the geometrical form as a cloud of 2943 points in the four dimensional Euclidean space. At the subsequent stage, the measure of distance between the points in \mathbb{R}^p is given by the following formula (Euclidean distance)

$$d_{r,s} = \sqrt{\sum_{i=1}^p (R_r^{(i)} - R_s^{(i)})^2}, \quad (3)$$

where the indicators $r, s = 1, \dots, 2943$ are the indicators of the daily observations and $R_r^{(i)}$ and $R_s^{(i)}$ are the empirical return rates of the i index in the days of r and s indexes. In the procedure of multidimensional scaling, we strive to find the linear transformation $a: \mathbb{R}^p \rightarrow \mathbb{R}^1$ meeting the optimality conditions of differences in distance between the points in \mathbb{R}^p and \mathbb{R}^1 . The daily return rates for the r index day for the entire industry will be approached as a vector and the marking $R_r = (R_r^{(1)}, \dots, R_r^{(p)})^t$, will be adopted where the operation " t " means the transposition of the vector. The linear transformation a yields the vector of return rates R_r into the number $a^t \circ R_r$, where the operation " \circ " signifies the scalar product of vectors. Thus, the name of the transformation has been identified with the vector determining this transformation. Additionally, let us introduce the symbol for the distance of linear transformation a for the return rate vectors in the days of the r and s indexes

$$\widehat{d}_{r,s} = |a^t \circ R_r - a^t \circ R_s|. \quad (4)$$

Formally the values $d_{r,s}$ are distances between return rates in the industry on different days and $\widehat{d}_{r,s}$ are distances between return rate in one-dimensional sub-space of \mathbb{R}^p . The idea of multi-dimensional scaling consists in finding such linear transformation α so that the value

$$V = \sum_{r=1}^n \sum_{s=1}^n (d_{r,s}^2 - \widehat{d}_{r,s}^2) \quad (5)$$

is the minimal. This means selection of an appropriate transformation (coefficient vector α for $i = 1, 2, 3, 4$) so that the distances between return rates in the industry on different days could possibly be precisely approximated by one-dimensional distances. The vector determining optimizing linear transformation is obtained from the empirical covariance matrix of return rates for the companies $R_r^{(i)}, i = 1, \dots, 2943$ of indexes $i = 1, \dots, p$, which is marked Σ . The covariance matrix Σ (of the $p \times p$ dimension) has the real and non-negative eigenvalues. Then making use of spectral decomposition of the matrix we discover that one - dimensional sub-space determining the scaled return rates is generated by the eigenvector of the maximal. Thus

$$\min_{\alpha \in \mathbb{R}^p} \left\{ \sum_{r=1}^n \sum_{s=1}^n (d_{r,s}^2 - \widehat{d}_{r,s}^2) \right\} = v_1, \quad (6)$$

where vector v_1 is the eigenvector of the covariance matrix Σ that is $\Sigma v_1 = \lambda_1 v_1$ where λ_1 is the maximal eigenvalue of the covariance matrix Σ . Additionally, the eigenvector has been selected in such a way so that it is normalized to unity and the project vector of the return rates on one-dimensional space generated on this vector has the positive covariance with each and every vector of empirical return rates for the companies within the industry.

Finally, the vector $R_r \circ v_1$ ($r = 1, \dots, 2943$) is the vector of the scaled return rates (industry indexes). Let us observe that the index form is given by formula (1) where weight vector α_i for $i = 1, 2, 3, 4$ is v_1 , vector, that is the eigenvector of the covariance matrix Σ corresponding the maximal eigenvalue. The construction of the industry index is based on the vector of return rate observations of the companies within the industry and generally the index values change as raw data changes for example by the increase in the amount of data.

The multidimensional scaling procedure is well known and frequently applied, but for tasks of a different nature. It is one of the basic procedures comprising data mining methods and is aimed at dimensionality reduction or cluster analysis. Technically, the multidimensional scaling procedure is analogical to Hotelling's Principal Component Analysis (1934). Proofs of the quoted values can be found in numerous monographs (Krzanowski, 2000), (Krzanowski, Marriott, 2010), (Mardia, Kent, Bibby, 1979), (Ripley, 1996).

3 Results and Discussion

Considering the industry indexes in the entire analysed period of observation we have noticed a minute dispersion level of the industry indexes (see table 1).

Table 1 Descriptive Statistics of the Industry Indexes

Industry index	N	Mean	SD	Min	Q05	Q50	Q95	Max
Energy	2939	0.060	3.202	-23.939	-4.855	0.108	4.561	24.887
Trade	1848	0.117	1.827	-9.030	-2.883	0.128	3.096	10.352
Finance	2942	0.076	5.003	-45.336	-6.397	0.037	6.211	51.369
Health	2942	0.058	2.180	-15.747	-3.276	0.089	3.303	21.853

Source: own research

The calculations indicate that regardless of the differences in the maximal values of indexes their extreme quantiles (order 5% and 95%) do not exceed 6,5%.

The aim of the research analysis is recreation of changes of the industry indexes in the observation period. It means the researchers are striving to find moments in time in which behavioural changes in the industry indexes are conspicuous.

The regression analysis is the first analysis aimed at evaluating return rates' behaviour. It has been observed that the regression line is a straight line almost identical to the abscissa in each of the industries (equation $y = 0$). As shown in table 2 the slope and intercept coefficients in all industries are insignificantly different than nought. However, quantiles of 5% and 95% order for residuals do not exceed 2%.

Table 2 Statistical Characteristics of Industry Regression Lines

Industry index	Min	Q05	Q50	Q95	Max	Slope	Intercept
Energy	-24.02	-1.47	0.06	1.54	24.81	0.473	-0.000028
Trade	-9.18	-1.08	0.01	1.12	10.18	1.025	-0.000058
Finance	-45.40	-1.62	-0.04	1.47	51.30	-0.171	0.000016
Health	-15.79	-1.02	0.02	1.08	21.81	-0.271	0.000022

Source: own research

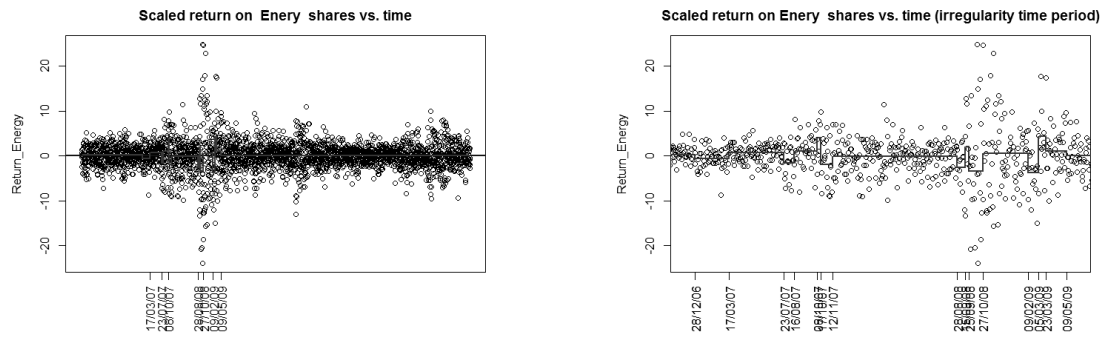
Applying simple regression analysis (CDA - confirmatory data analysis) it may seem that the industry indexes are insignificant. It is not the case, however, and indexes are endowed with structural changeability resulting from fluctuations in stock market. This changeability is relatively minor in comparison with the aggregate of observation containing approximately 2.5 K. pieces of information. Analytical tools which hinge on parametrical procedures are not precise enough to detect minute dependencies.

The detailed industry index analysis is to be carried out with the application of the basic methods belonging to the set of exploratory data analysis (EDA) tools, frequently referred to as data mining. Tree-base method adopted for our research appear in the literature on the subject matter. First formal algorithms were presented in 1963 (Chambers, Hastie, 1993). Main outcomes are to be found in Brieman's monographs of 1984 (Breiman, Friedman, Stone, Olshen, 1984).

The method of recreating the structure of changes in the industry index is, in theory, based on the so called quantization process. At the first stage, we pinpoint a moment (date) separating observations into an earlier and a later one in relation to a given date. A moment in time is selected in a way which enables minimising the sum of variance of observations in two analysed aggregates. The same mode of operations is performed at subsequent stages. The process may be conducted until final single measurements are obtained. However, the image of results obtained would be illegible. For this reason it is imperative that we should introduce a selection of parameters allowing for termination of the process. Two conditions have to be adopted in the applied procedure. It has been assumed that each group at each stage of division includes at least seven days of observations. Additionally, it has been agreed that 180-day periods are indivisible. The standard division-stopping procedure based on the relative variance in division related to the variance before and after division has not been applied.

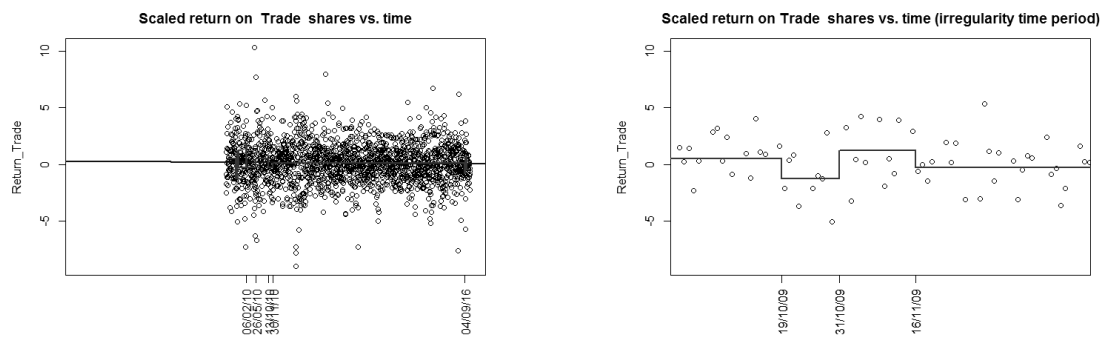
Please consider the following point graphs of variability in the industry indexes. Average index values in selected time periods have been attached to the industry indexes.

Figure 1 Changeability of the Energy Industry Index (EI2)



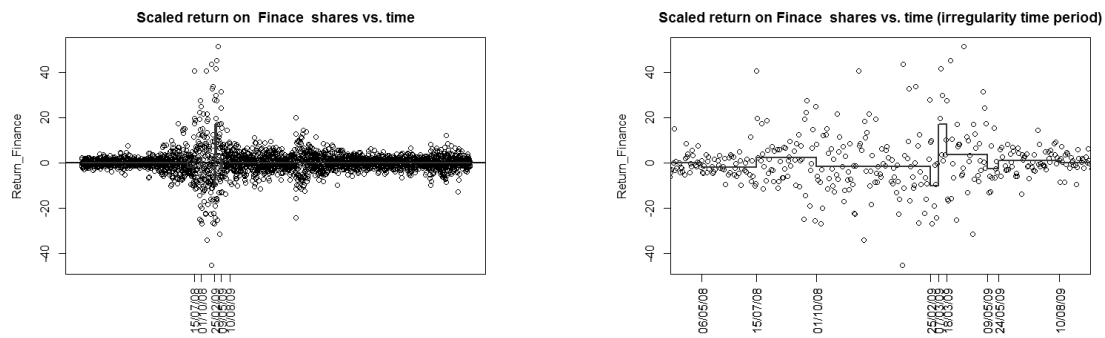
Source: own research

Figure 2 Changeability of the Trade Industry Index (TI2)



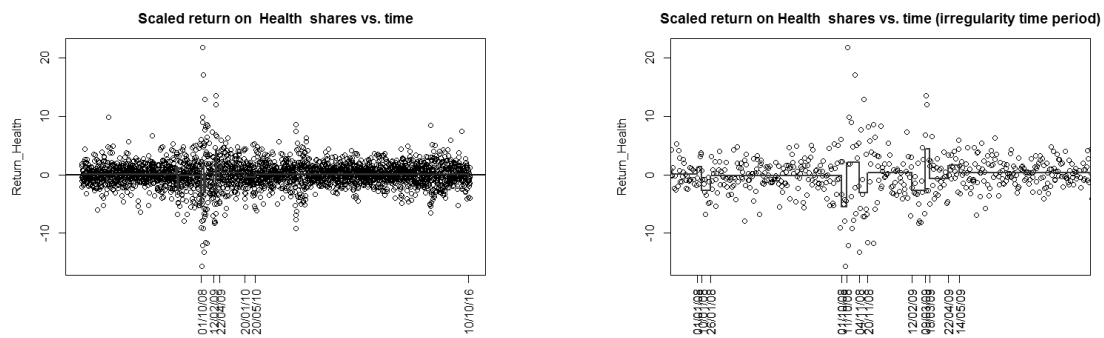
Source: own research

Figure 3 Changeability of the Finance Industry Index (FI2)



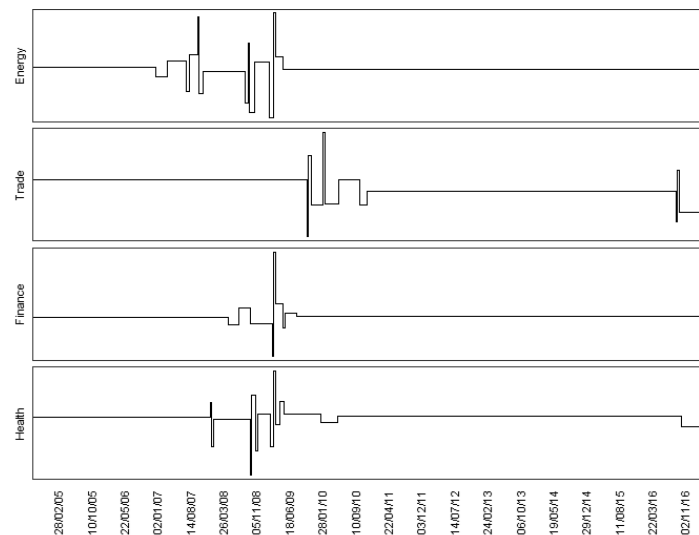
Source: own research

Figure 4 Changeability of the Health Industry Index (HI2)



Source: own research

Figure 5 The Structure of Behavioural Homogeneity of Return Rates' Indexes in Researched Industries



Source: own research

Figure 5 presents the structure of changes in industry indexes (I2) in the entire observation period. The conducted research leads to the conclusion that the changeability structure of industry indexes is heterogeneous in the time in the analysed industries. The energy industry is first to manifest the industry index instability. The middle ground belongs to the health and finance industries. Evidently, the trade industry is last to demonstrate the instability phenomenon. The final comparative analysis of instability requires rescaling of changes in industry indexes to achieve the same scale. The detailed pictures of changes in industry indexes is presented in figures from 1 to 4.

4 Conclusions

This article attempted to evaluate the behavioural homogeneity of return rates on shares based on American stock exchange (NYSE) and taking into account divers industries represented particular enterprises.

The research carried out proves that:

1. There appears to be behavioural homogeneity of industry indexes (at the level of regression analysis).
2. Behavioural heterogeneity in selected industries has been discovered owing to the application of the analysis incorporating data mining tools.

3. The energy industry has been first to reveal behavioural instability. Subsequently, it has appeared in the health, finance and trade industries.

4. Despite the lengthy research period the instability of industry indexes appeared at a similar time in all industries (2007-2010). Please note that this time period overlaps with the global recession in financial markets.

5. In addition it is worth noticing that behavioural instability of trade and health industries manifested itself at the end of the research time period (IX-X 2016). It justifies an increase in risk related to the next phase of crisis in the financial market. It may be correlated with the global political situation.

The work has demonstrated the existence of behavioural heterogeneity of rates of return on shares in selected industries. The future research in this domain ought to concentrate on conducting a thorough analysis of homogeneity structure in selected industries so as to determine some regularities in the behaviour share prices in the particular industries.).

References

Breiman, L., Friedman, J., Stone Charles, J., Olshen, R. A. (1984). *Classification and Regression Trees*. Florence: Wadsworth.

Chambers, J. M., Hastie, T. J. (1993). *Statistical Models in S*. London: Chapman & Hall.

Fama, E. F. (1970). Efficient capital markets: A review of theory and empirical work. *Journal of Finance*, vol. 25(2), pp. 383-417.

Fama, E. F., French, K. R. (1992). The cross-section of expected stock returns. *Journal of Finance*, vol. 47(2), pp. 427-465.

Fama, E. F., French, K. R. (1996). The capm is wanted, dead or alive. *Journal of Finance*, vol. 5(5), pp. 1947-1958.

Krzanowski, W. (2000). *Principles of Multivariate Analysis: A User's Perspective*. New York: Oxford University Press.

Krzanowski, W., Marriott, F. H. C. (2010). *Multivariate Analysis v. 1 (Kendall's Library of Statistics)*. New York: John Wiley & Sons.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics*, vol. 47(1), pp. 13-37.

Mardia, K. V., Kent, J. T., Bibby, J. M. (1979). *Multivariate analysis*. London-New York-Toronto-Sydney-San Francisco: Academic Press.

Markowitz, H. M. (1952). Portfolio selection. *Journal of Finance*, vol. 7(1), pp. 77-91.

Mossin, J. (1966) Equilibrium in a capital asset market. *Econometrica*, vol. 34(4), pp. 768-783.

Ripley, B. D. (1996). *Pattern Recognition and Neural Networks*. New York: Cambridge University Press.

Roll, R. (1973). A critique of the asset pricing theory's tests: Part. 1: On past and potential testability of the theory. *Journal of Financial Economics*, vol. 4(2), pp. 129-176.

Ross, S. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory*, vol. 13, pp. 341-360.

Samuelson, P. (1965). Proof, that properly anticipated prices fluctuate randomly. *Industrial Management Review*, vol. 6(2), pp. 41-49.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance*, vol. 19(3), pp. 425-442.

Treynor, J. L. (1961). Market Value, Time and Risk (Unpublished Manuscript).

Stability Prerequisites of the Czech Republic Banking System (Cybernetic Point of View)

František Kalouda

MASARYK UNIVERSITY

Faculty of Economics and Administration, Department of Finance

Lipová 41a, 602 00 BRNO, Czech Republic

E-mail: email@university.cz

Abstract: *The paper is devoted to further description and analysis the selected stability aspects of the Czech banking system (as a cybernetic system), with special focus to the influence of the managed or controlled system (commercial banks). The objective of the paper is to clarify the implications of the parameters of the regulator (Czech central bank) to behavior the managed/controlled system (Czech commercial banks). The paper draws on data published by the Czech National Bank (CNB, <http://www.cnb.cz>) as well as on data from literature and from previous studies of the author. Methodology of the paper is principally based on the economic cybernetics utilization in terms of study the stability of the Czech banking system as a cybernetic one. The usual description, literary research, comparison and analytic-synthetic methods are used here as well. The main expected results of the paper relate to the linkages between stability of the Czech banking system as a whole and behavioral parameters (characteristics) of the controlled system (commercial banks) - still not explored. Conclusions of the paper in a significant way redefine the options of the central bank in general (this means not only Czech central bank) concerning the stability control of the banking system.*

Key words: banking system, controller, stability, controlled system

JEL codes: C62, D22, E43, G21, G38

1 Introduction

The stability of the cybernetic system in general is result of interaction of the controlled system/plant and controller.

Their standard interconnection in form of the simplest block diagram is a closed-loop (or feedback) control system with negative feedback (see Figure 1).

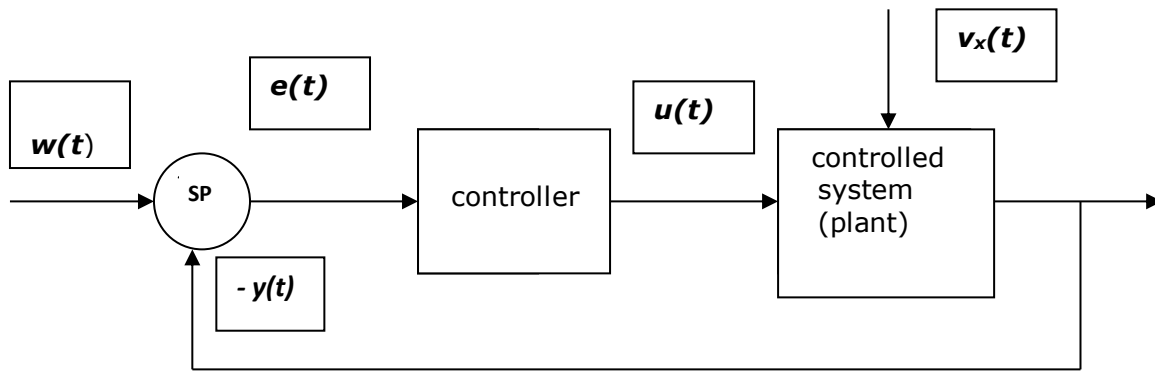
In our case we are specifically monitoring stability of the Czech banking system. The controlled system (plant) is system of Czech commercial banks (hereinafter Czech commercial banks). As the controller performs Czech National Bank (hereinafter CNB), Czech Central Bank.

We examine the stability of the Czech bankin system through relationships between the indicators (or variables) discount rate and commercial rate. The reason for choosing these indicators is the CNB's view that commercial rate can be managed (with sufficient precision) by a discount rate.

The formal independence of the CNB leads to significant modification of the standard block diagram of a closed-loop or feedback control system (see Figure 2). The feedback control system is preserved indeed but its ability of target behaviour is in the absence of command variable $w(t)$ - and implicitly also variable $e(t)$ error - at least disputable.

The other consequences of the CNB's independence are here ignored.

Figure 1 Block Diagram of a Closed-loop (feedback) Control System – Classic Form



Legend:

$w(t)$ command variable

$e(t)$ error

$u(t)$ manipulated variable

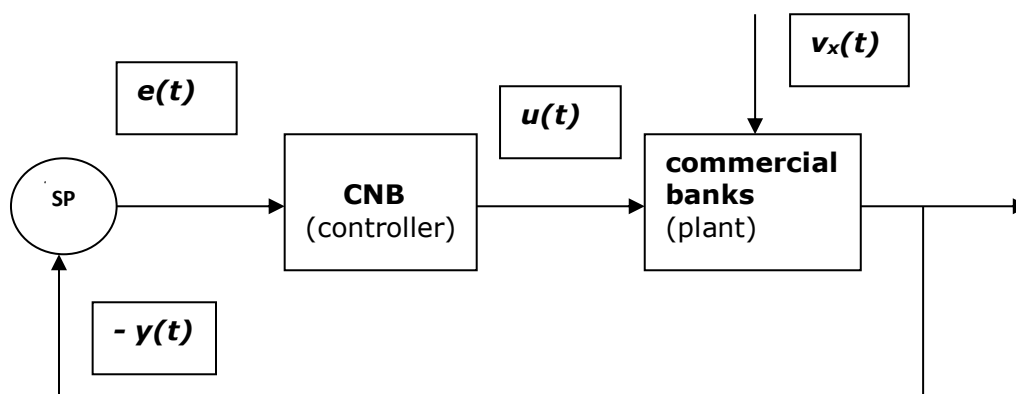
$v_x(t)$ disturbance variables

$y(t)$ controlled variable

SP summing point ($e(t) = w(t) - y(t)$)

Source: Adapted from Švarc et al. (2011, pp. 38, 341), Stefani, R.T. et al (2002, p. 75)

Figure 2 Block Diagram of a Closed-loop (feedback) Control System – Consequence of CNB Independence



Legend:

$w(t)$ command variable

$e(t)$ error

$u(t)$ manipulated variable

$v_x(t)$ disturbance variables

$y(t)$ controlled variable

SPsumming point ($e(t)=w(t)-y(t)$)

- unknown/missing signal/information, it cannot be interpreted

- " -

- unknown component, it cannot be defined

Source: Own construction of the author based on Švarc et al. (2011, pp. 38, 341), Stefani, R.T. et al. (2002, p. 75)

The past results of identifying the parameters of commercial bank system (Balátě (2004), Fikar, Mikleš (1999), Kubík et al (1982), Švarc (2003) and Švarc et al (2011)) are relatively convincing. The dynamic behaviour of this system is analyzed using the step function response of the banking system $h(t)$. The step function (or transient) response of commercial bank system $h(t)$, as it has been analyzed to date ((Kalouda (2014a), (2014b), (2014c), (2015))), leads us to the partial conclusion that (from a dynamic point of view) system of commercial banks can be considered as proportional (static) system element.

Nevertheless, the available data does not rule out a tendency of this system to oscillations with a potential risk of destabilizing the system ((Kalouda (2014a), (2014b)).

It is clear that the risks of the system oscillating into an unstable regime is too large to be ignored. The step function response of the Czech banking system in its different periods are, after all, not identical to each other (Kalouda, 2015), which evokes a risk that the stability of the system may be lost.

This is why this paper is devoted to examining the dynamical behavior of the banking system in the Czech Republic with special focus to its stability. In this context the objective of the paper is to clarify the influence of controller's (CNB) parameters on behaviour of the controlled system (Czech commercial banks, plant).

2 Methodology, Data and Model Specification

The limited extend of the paper makes impossible to provide a detailed presentation of all methodological procedures that led to the results presented below. Therefore, we will limit ourselves to the brief overview of the most important topics discussed, in connection with the relevant sources.

Methodology

The key importance of the methodological input for this paper results first of all from the interdisciplinary nature of the issues studied. On the other hand they are also relevant in this context the researches previously carried out and the publications of the results achieved, to which this paper is closely tied.

The methodical basis of the paper are the usual methodological procedures:

- description,
- analysis,
- comparison, and
- synthesis.

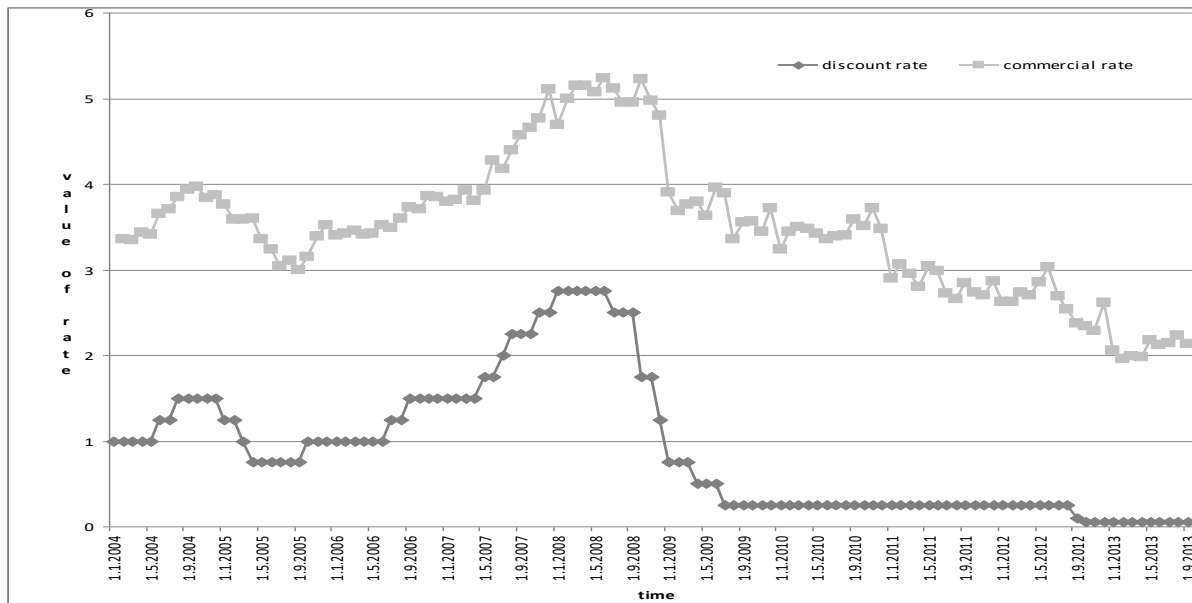
In addition, however, the specific topic and the objective of the paper virtually forced the application of methodological tools which have been less frequently used in the given context. These include, in particular:

- technical cybernetics, explaining the principles of automatic control in the form of feedback systems represented by Balátě (2004), Fikar and Mikleš (1999), Houpis and Sheldon (2014), Kubík et al. (1982), Švarc (2003), Švarc et al. (2011),
- economic cybernetics, transforming the methodology of technical cybernetics into the environment of economic systems, as discussed by Allen (1971), Šerý (2010), Kalouda and Svítal (2009), and Kisačanin and Agarwal (2001) and
- financial business management in the form of applications of its access to economic cybernetics, as illustrated by Kalouda (2015, 2016).

Data

This paper is primarily based on freely available data published by the Czech National Bank (CNB) at http://www.cnb.cz/cs/financni_trhy/penezni_trh/pribor/rok_form.jsp, and at http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS, to which we link here. This data is taken from the period 31/01/2004 until 30/09/2013. The values of the variable discount rate and commercial rate are monitored (see Figure 3 Commercial rate = f (discount rate)).

Figure 3 Commercial Rate = f (discount rate)



Source: Prepared by the author using data from ARAD - Time series system - CNB. [on-line]
Retrieved from: http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS
[Accessed on 26/11/2013]

The above mentioned data are essentially unusable for the given purpose in their original form. The necessary modifications are described and justified in Kalouda (2017).

Model Specification

In this case, the modelled object is the banking system of the Czech Republic. We model the processes of managing cost of capital at the level of businesses (commercial rate) by the CNB using the discount rate. The model of this system is the graphical representation of the dependence of the commercial rate on the discount rate.

This relatively simple model is, in principle, based on the assumption that the requirement for the linearity of the modelled system is met (Švarc et al., 2011). Therefore we only consider the data that complies with the linearity condition, i.e. the reactions the commercial rate response to a rise in the discount rate.

However, this model is able to describe the expected non-linearities that are typical for the banking system with sufficient accuracy. The relative simplicity of the model used is thus not an obstacle to its use for describing the situation and identifying the problems in order to obtain the reference characteristics of the examined system (Fikar and Mikleš, 1999).

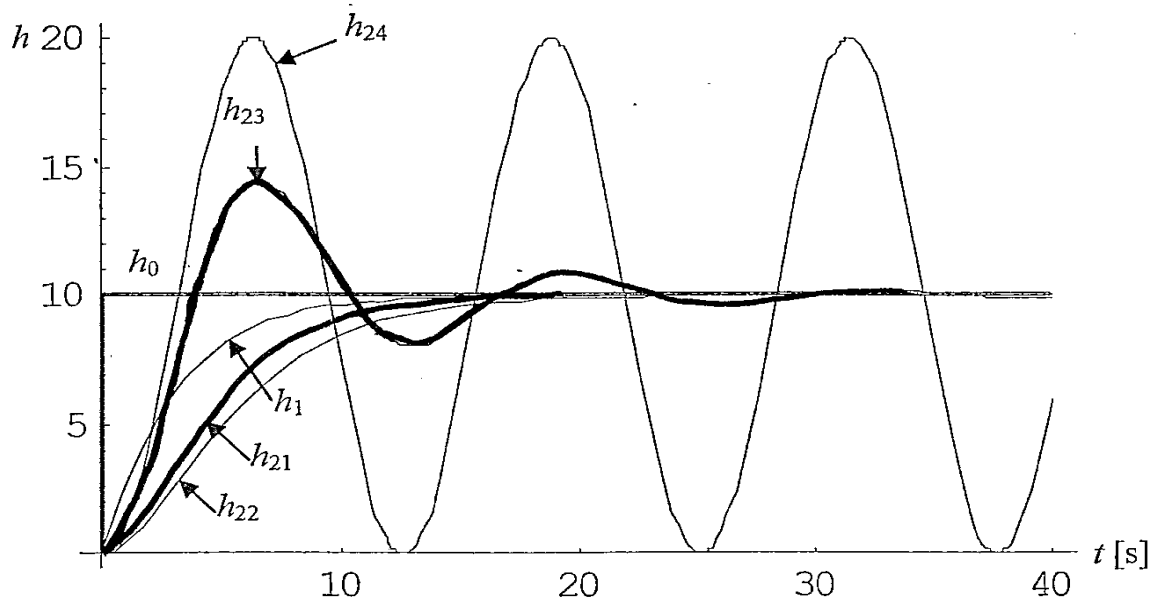
3 Results and Discussion

As mentioned above, results of previous research lead to the conclusion that (from a dynamic point of view) system of Czech commercial banks (or plant) can be considered as proportional (static) system element. Its dynamic behaviour, however, can be very different from the usual concept of stability.

Proportional (static) system element/plant – dynamics of behaviour

Behaviour of system elements (plant) can be described by using the step function response $h(t)$. Its shape determines the parameters of the system elements, in this case parameters of the Czech commercial banks. Depending on these parameters, step function response $h(t)$ may take the form as shown in Figure 4.

Figure 4 Variants of the Step Function Response $h(t)$



Legend:

h_0 step response of an proportional element without inertia (an ideal proportional element)

h_1 step response of an first-order proportional element with inertia (aperiodic first-order element)

h_{21} step response of an second-order aperiodic element (critically damped)

h_{22} step response of an second-order limit aperiodic element (over-damped)

h_{23} step response of an second-order oscillating element (under-damped)

h_{24} step response of an second-order conservative (lossless) element (on the threshold of instability, un-damped)

Source: Adapted from Balátě, J. (2004, pp. 57-58, Figure 3.21), Poley, R. (2014, p.18, Table 1.10)

Behaviour of system element (plant) is critically significant to the stability control of the system (in this case the CR banking system). It is defined by the nature of the system element.

The dynamic behaviour of the Czech commercial banks tested previous research (Kalouda, 2015). We can be considered proven that this system is able (considering unit step response $h(t)$) to respond by all above-mentioned ways.

Proportional (static) system element controller (as a technical system)

From the above, it is obvious that the nature of the system element (plant) is important for the selection of the controller as well. „The choice of the structure or type of controller is therefore largely determined by the nature of the system element (plant).” (Balátě, 2004, p. 221).

The basic characteristics (parameters) theoretically applicable controllers (as technical systems) are shown in Table 1.

Table 1 Theoretically Applicable Controllers (Overview)

controller	$e(t)$	quality	stabilization
P controller	stable	good	
I controller	temporary	good	
PI controller	0	better then	I controller
PD controller	0	better then	P controller
PID controller	0	the best	

Legend:

P controller – proportional controller

I controller – integral controller

PI controller – proportional plus integral controller

PD controller – proportional plus derivative controller

PID controller – proportional plus integral plus derivative controller

Source: Adapted from Balátě, J. (2004). *Automatické řízení*, Praha: BEN, pp. 155-156, Švarc, I., Matoušek, R., Šeda, M., Vítečková, M. (2011). *Automatické řízení*, 2nd ed. Brno: CERM, pp. 97-100

The last step is assigning the controller to the Czech commercial banks system. Theory of the technical cybernetics (automatic control) is in this case relatively unambiguous – only higher type controllers (PI, PD a PID) are suitable for higher order systems (it means second-order or higher) – see Table 2.

Table 2 The Order of the Controlled System (Plant) and Suitable Controller

plant /system element	controller				
	I	P	PI	PD	PID
proportional element without inertia (zero-order ideal proportional element)	/	/	/	/	/
aperiodic first-order element (proportional)	/	/	/	/	/
second-order aperiodic element (both proportional and integral)			/	/	/
second-order limit aperiodic element (both proportional and integral)			/	/	/
second-order oscillating element (both proportional and integral)			/	/	/
second-order conservative (lossless) element (on the threshold of instability)			/	/	/

Source: Adapted from Balátě, J. (2004). *Automatické řízení*, Praha: BEN, pp. 99,222, Švarc, I., Matoušek, R., Šeda, M., Vítečková, M. (2011). *Automatické řízení*, 2nd ed. Brno: CERM, pp. 56-57

Proportional (static) system element/plant – CNB as a controller

It should be considered that controller is in this case a group of human individuals (Board of CNB). With all the advantages and disadvantages. The competence of the Board members are exceptional and, on the other side of hand, the risk of erroneous decisions is also exceptional.

It is obvious, that full analogy of technical and economic systems (with a strong human aspects - i.e. behavioral) is not possible. Nevertheless Allen (1971, p. 270) emphasizes in these terms unequivocal opinion: „There is necessary only the formal similarity to anticipate that the methods used in technics will be suitable for economic models too.“ In this context we assume, that this condition is in this case met (with sufficient accuracy off course).

This issue will be (among others) the subject of the further research activities.

4 Conclusions

Cybernetic modeling the behavior of the Czech banking system is a long term deal on the finance department of the ESF MU – more systematically we are dedicated to the topic during the last five years. In overwhelming majority, the results obtained are very interesting and regularly break the myths about the CNB's management potential.

In this paper, we discuss the stability of the Czech banking system with regard to the capital cost management processes.

The focus of our interest is the choice of controller, which would guarantee the stability of the Czech banking system. Result of the research is as follows:

- system of Czech commercial banks acts as a proportional first/second-order system,
- this system faces potential instability due to inappropriate management intervention,
- the controller of this system should have the control potential of the entire range of controllers (namely type I, P, PI, PD and PID controllers), preferably in the form of a PID controller.

The subject of the further research will be:

- detailed description and analysis of the technical aspects of the matter (transmission coefficient k , damping ratio ξ , time delay T_D etc.),
- transformation of the technical cybernetics approaches to stability management into the approaches of the economic cybernetics in order the stability control of the Czech banking system (with a strong human aspects), and
- objectivization of the need for CNB interventions, which is a particularly sensitive issue, because of theoretical knowledge available on this subject (so far unique), are truly alarming! For the proportional controlled system it is true that: "... after deflection from the equilibrium state, they are able to theoretically always achieve a new equilibrium state without any intervention (connection) of the controller." (Balátě, 2004, p. 113).

Acknowledgments

This paper was written with support from the project „Behavioral, Knowledge and Economic Aspects Affecting the Decision-Making Subjects (MUNI/A/0753/2017 - Behaviorální, znalostní a ekonomické aspekty ovlivňující investiční rozhodování subjektů).

References

- Allen, R. G. (1971). *Matematická ekonomie*. Praha: Academia.
- Balátě, J. (2004). *Automatické řízení*. Praha: BEN.
- Fikar, M., Mikleš, J. (1999). *Identifikácia systémov*. Bratislava, STU Bratislava.
- Česká národní banka (2018). *Sazby PRIBOR – roční historie*. Data retrieved from: http://www.cnb.cz/cs/financni_trhy/penezni_trh/pribor/rok_form.jsp.
- Česká národní banka (2018). Data retriever from: http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS
- Houpis, C. H., Sheldon, S. N. (2014). *Linear Control System Analysis and Design with MATLAB*. 6th ed. New York: CRC Press
- Kalouda, F. (2014a). Řízení ceny kapitálu centrální bankou jako kybernetický proces. In: *Recenzovaný sborník mezinárodní odborné konference Hradecké ekonomické dny 2014*. Hradec Králové: Gaudeamus, vol. 4(1), pp. 83-88.
- Kalouda, F. (2014b). The Impact of Discount Rate on Commercial Rates in the Czech Republic: The Cybernetic Approach. In: *Proceedings of the 11th International Scientific Conference European Financial Systems 2014*. Brno: Masaryk University, pp. 307-313.
- Kalouda, F. (2014c). The hysteresis erosion of the discount rate control potential in CR conditions – behavioral solution. In: *Managing and Modelling of Financial Risks*. Ostrava: VSB – Technical University of Ostrava, pp. 329-334
- Kalouda, F. (2015). The Banking System of the Czech Republic as a Cybernetic System – the Unit Step Response Analysis. In: *Proceedings of the 12th International Scientific Conference European Financial Systems 2015*. Brno: Masaryk University, pp. 253-261.

Kalouda, F. (2016). Fenomén stability bankovní soustavy ČR v řízení úrokového rizika podniku. In: *Managing and Modelling of Financial Risks*. Ostrava: VSB – Technical University of Ostrava, pp. 379-386

Kalouda, F. (2017). Negative interest rates – consequence staying in error? (empirical evidence). In: *Proceedings of the 14th International Scientific Conference European Financial Systems 2017*. Brno: Masaryk University, pp. 290-299.

Kalouda, F., Svítal, M. (2009). The Commercial Bank such as the Cybernetic System in Conditions of the Global Financial Crisis. In: *Management, Economics and Business Development in European Conditions*. Brno: FP VUT, pp. II.24-II.31.

Kisacanin, B., Agarwal, G. S. (2001). *Linear Control Systems with solved problems and MATLAB examples*. New York: Kluwer Academic/Plenum Publishers.

Kubík, S., Kotek, Z., Strejc, V., Štecha, J. (1982). *Teorie automatického řízení I, Lineární a nelineární systémy*, Praha: SNTL.

Poley, R. (2014). *Control Theory Fundamentals*. 2. ed. Marston Gate: CreateSpace Independent Publishing Platform.

Stefani, R. T., Shayan, B., Savant, C. J. Jr., Hostetter, G. H. (2002). *Design of Feedback Control Systems*. 4. ed. New York: Oxford University Press.

Šerý, M. (2010). *Vliv diskontní sazby na úrokové sazby komerčních bank v České republice*. Brno: Mendelova univerzita, Provozně ekonomická fakulta. Bachelor's Thesis.

Švarc, I. (2003). *Teorie automatického řízení*. Brno: FS VUT.

Švarc, I., Matoušek, R., Šeda, M., Vítečková, M. (2011). *Automatické řízení*. 2nd ed. Brno: CERM.

How the Changes in Exchange Rate Affect the Turkish Economic Growth under Inflation Targeting Regime?

Özcan Karahan

¹ Bandırma Onyedi Eylül University
Faculty of Economics and Political Sciences, Economics Department
Merkez Yerleşkesi, 10200, Bandırma-Balıkesir, Turkey
E-mail: okarahan@bandirma.edu.tr

Abstract: *In the literature, the conventional view argues that there is a positive relationship between exchange rate and economic growth since an increase in exchange rate stimulates the volume of net exports. However, Structuralist Economists show that there may be an inverse relationship between exchange rate and economic growth. Particularly in developing countries, the input structure of production depends on the imported capital and intermediate goods, so an increase in the exchange rate negatively affects the economic growth by making imported production inputs more expensive. Turkey, leaving exchange rates free to fluctuate, have adopted Inflation Targeting (IT) as a monetary regime since 2001 and thus exhibited a genuine experience to be analysed the role of exchange rate in economic growth. Accordingly, using quarterly data from 2002 to 2017 and employing Johansen cointegration and Granger causality tests, the nexus between exchange rate and economic growth has been investigated in this study. Empirical findings indicate that, as argued by Structuralist Economists, there is a negative causal relationship from exchange rates to economic growth. From the policy perspective, it can be concluded that monetary policy applications in Turkey should provide both price and exchange rate stability together under inflation targeting regime.*

Keywords: exchange rate, economic growth, Time-Series Model

JEL codes: F31, F43, C22

1 Introduction

The economic effects created by exchange rate changes have been the subject of constant debate in the literature. With the spread of the financial liberalization period, discussions about the effects of the exchange rate on the macroeconomic variables have increased even more. Recently, deep attention has been given to examination of the link between exchange rate and economic growth. Thus, the effect of exchange rate changes on economic growth is one of the important research issues in the literature today.

Conventional view argues a positive causality relationship from exchange rate to economic growth. According to this approach, an increase in exchange rate stimulates economic growth via enlarging the volume of net export. Rising exchange rate affects the relative prices of domestic and foreign goods and hence increases exports and decreases imports. In other words, depreciation of the local currency directs the demand for foreign commodities to local products. As a result, when the exchange rate raises, it will enhance economic growth by promoting net exports. Thus, devaluation can be used as an effective policy tool to encourage economic growth.

However, the Structuralist Economists suggest that devaluation policy may have a constrictive effect on the economies of developing countries in particular. The manufacturing process of developing countries is largely based on imported inputs such as machinery and intermediate goods. Thus, with the increases in the exchange rate, the costs of imported input and accordingly the cost of production increase significantly. As a result, increased production costs will slow production and in this case leads to a decrease in total supply and economic growth. Therefore, in developing countries there is a negative causality from exchange rate to economic growth.

To sum up, the transmission mechanism between exchange rate and economic growth can be examined in two respects. In other words, it is appropriate to determine the impact of exchange rate on economic growth through two channels. According to the conventional view, the exchange rate increase has a positive effect on the economic growth by increasing the net export volume. Thus, there is a positive causality relation from exchange rate to economic growth. On the contrary, the Structuralist Economists argue that the exchange rate increase, especially in developing countries, has a negative effect on economic growth since exchange rate increase reduces the imported production input which is intensively used in the production process. For this reason, they assert that there is an inverse relationship between exchange rate and economic growth.

The aim of this paper is to make a contribution to the debate in the literature indicated above. Accordingly, the relationship between exchange rate and economic growth in Turkey will be analysed using the Johansen cointegration and Granger causality tests for the quarterly data between 2002 and 2017. Following the economic crisis in 2001, within the framework of Inflation Targeting Regime, the exchange rate in Turkey was allowed to float. Thus, Turkey provides a genuine experience to be analysed the role of exchange rate in economic growth. The rest of paper is arranged as follows. Section 2 reviews the empirical literature focusing on the relationship between exchange rate and economic growth. Section 3 explains the data and methodology. Section 4 presents empirical results. Final section concludes and makes some policy implications.

2 Literature Review

There are two different hypotheses in the literature about how exchange rate affects economic growth. In other words, there are two different perspectives on the effect of exchange rate on economic growth. Conventional approach asserts that rising exchange rate positively affects economic growth while Structuralist view argues that rising exchange rate brings about a contraction in the economy.

According to Conventional view, an increase in exchange rate creates a positive impact on economic growth via enhancing the volume of net export. The main reason for the increase in economic growth with net exports here is the change in the relative prices of domestic and foreign goods after the increase in exchange rates. Namely, depreciation of local currency decreases the prices of domestic goods while makes the prices of goods abroad much more expensive. Thus, depreciation of exchange rate firstly increases the volume of net export and then growth rate of economy. That means devaluation can be used as a policy tool promoting economic growth. Accordingly, the positive impact of currency depreciation on economic growth has been widely documented in the literature. Indeed, mainstream studies have mostly produced the econometric results concerning with the positive correlation from exchange rate increase to net export and economic growth.

Domaç (1997), for the period 1960-1990, examined the relationship between exchange rate and economic growth in Turkey. Using regression analysis, he found that unexpected devaluations are a positive effect on output. Thus, he determined that the contractionary devaluation hypothesis is not valid in Turkey. Narayan and Narayan (2007) investigated the effects of devaluation for the Fiji economy between 1970-2000. They employed the co-integration method and found that the devaluation in the short and long term led to widening effect for the Fiji economy. They found that 10% devaluation increased the output by 2.3% or 3.3%. Rodrik (2008) examined the relationship among economic growth and real exchange rates using a data set from 188 countries between 1950 to 2004. Rodrik found a systematic positive relationship between growth and depreciation in the real exchange rate. However, the increase in the depreciation of the real exchange rate has only caused to economic growth only in some developing countries. According to him, this relationship does not apply to developed rich country economies.

Di Nino et al. (2011) analysed the connection between exchange rate and economic growth in Italy. They concluded that there is a positive relationship between undervaluation and economic growth for a dataset covering the period 1861-2011. In addition, the authors also showed that undervaluation supported growth by increasing exports, especially in

high-productivity sectors. Chen (2012) focused on the role of exchange rate in economic growth and the convergence of growth rates in Chinese provinces. Data set between 1992 and 2008 for 28 provinces were tested with dynamic panel data estimation. He found that real exchange rate increase has a positive effect on the economies of provinces. Aman et al. (2013) investigated the relationship between exchange rate and economic growth in Pakistan for the period 1976–2010 by employing two, three stage least square techniques. They showed that exchange rate has a positive impact on economic growth through the promoting export and import substitute industry. Habib et al. (2017) analysed the impact of movements in the real exchange rate on economic growth based on five-year average data for a panel of over 150 countries in the post Bretton Woods period. They determined that a real depreciation raises annual real GDP growth. Thus, the results revealed the broader economic effects of devaluation for developing countries.

As seen in the literature, many studies have found that the rising exchange rate ratio has a positive impact on the economy and thus supported the devaluation policy for economic growth. However, Structuralist economists have argued that the rising exchange rate has a restrictive effect on economic growth, especially in developing countries. Therefore, devaluation policy creates confining impact on the growth of developing economies (Bird and Rajan 2004:143-144). The negative impact of increases in exchange rates on economic growth arises from the restrictive effects on imported input. The production structure of developing countries is mainly dependent on the imported input. Therefore, the increases in the exchange rate create a negative impact on economic growth by decreasing the imports of raw materials, intermediate goods and investment goods. That's why the devaluation policy produces positive outcomes in some developed countries while it results in negative consequence on economic growth in developing countries (Hallwood and Macdonald, 2003:421).

Furthermore, it has been argued that import affects growth in developing countries by transferring of new knowledge or technology from abroad. Thus, import affects economic growth in developing countries by not only providing production input but also enhancing the domestic technological capability. Imported machinery and intermediate goods generates the channels for diffusion of new technology among countries. Therefore, it is clear that import have the impact on developing countries' growth by raising technological capacity of economy through transferring new knowledge. The important role of imports in technological diffusion has been extensively documented in the literature. (Lee 1995; Mazumdar 2001; Keller 2004).

In conclusion, rising exchange rate which causes imports to be restricted decreases economic growth by both reducing the availability of production input and technology transfer. Accordingly, many studies in the literature have shown that depreciation of the local currency caused to a contraction in the economies of developing countries. Bahmani-Oskooee et al. (2002) examined the transfer mechanism from exchange rate to economic growth in 5 Asian countries using the monthly data between 1976 and 1999. The empirical results of Johansen cointegration and Granger causality tests indicated that depreciation of local currencies have a negative impact on economic growth in Asian countries. Galindo and Montero (2005) investigated the causality relationship from exchange rate to economic growth by using panel data relating to 9 Latin American countries. Empirical results indicated that rising exchange rate in the Latin American countries which have high foreign debt ratio negatively affects economic growth. Yiheyis (2006) investigated the interaction among the exchange rate and economic growth in 20 African countries for the term 1981-1999. The results of unbalanced panel data analysis indicated that depreciation of local currencies creates a shrinking effect on economic growth.

Blecker and Razmi (2008) examined the impact of devaluation on economic growth in 17 developing countries for the period 1983-2004. Results of dynamic panel data analysis (Generalised Method of Moments) showed a negative relationship between exchange rate and economic growth. As a result, the authors emphasize that contractionary effect of devaluation for developing countries compared to industrialized countries. Vaz and Baer (2014) employed a panel model using unbalanced panel data covering 1995-2008 for a

sample of 39 countries. They showed that depreciation of currency in Latin American countries causes a nominal cost increase in production process and hence decreases economic growth rate rather than raises it. Çelik et al. (2017) investigated transfer mechanism from exchange rate to economic growth via panel data analysis using cross-sectional data between 1995 and 2014 for 12 transition economies in Eastern Europe and Middle Asia. The results of study showed that an increase in exchange rate result in economic downturn. However, they also indicated that real exchange rate movements do not turn out to be the major variable in explaining the economic growth.

3 Data and Methodology

The aim of the study is to examine the relationship between exchange rate and economic growth using quarterly data between 2002-Q1 and 2017-Q4. The variables of exchange rate (ER) and economic growth rate (EG) are sourced from Electronic Data Delivery System in Central Bank of the Republic of the Turkey. Empirical analysis begins by checking the stationary statute of data set by using Dickey and Fuller and Phillips-Perron Tests. Then, the long run relationship between inflation and interest rate is analysed by using Johansen (1988) Cointegration Test. Finally, we examine the causality relationship between inflation and interest rate by operating Granger (1988) Causality Test based on Error Correction Model.

The stationarity analyses of the variables were performed with the ADF (Augmented Dickey Fuller-ADF) and PP (Philips Perron) unit root tests. The constant model used in the unit root tests developed by Dickey and Fuller (1981) can be shown as equation 1. Test results determined by estimation of these model are evaluated in terms of critical values of MacKinnon and the null hypothesis ($H_0: \alpha = 0$) is tested against the alternative hypothesis ($H_1: \alpha \neq 0$). The null hypothesis indicates that the series is not stationary, while the alternative hypothesis suggests that the series is stationary.

$$\Delta Y_t = \beta_0 + \alpha Y_{t-1} + \sum_{i=1}^m \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

The unit root test developed by Phillips-Perron (1988) is based on the model determined in Equation 2. In this equation T determines the number of observation while t indicates time. Test results determined by estimation of these model are evaluated in terms of critical values of MacKinnon. The null hypothesis ($H_0: \lambda = 0$) is tested against the alternative hypothesis ($H_1: \lambda < 0$). The null hypothesis states that the series contain unit root while the alternative hypothesis states that the series do not contain unit root.

$$\Delta Y_t = \delta_0 + \lambda Y_{t-1} + \delta_1 (t - T/2) + u_t \quad (2)$$

The cointegration test developed by Johansen and Juselius (1990) is suitable for examining the long-term relationship between variables after determining that the data are stable at the same level. This method makes an analysis of cointegration over the system of simultaneous equations generated by using variables that become stable at the same time when the difference is taken. In the framework of this methodology a VAR (Vector Autoregressive) Model with p degree in Equation 4 is operated.

$$Y_t = \mu + \alpha Y_{t-1} + \dots + \alpha_p Y_{t-p} + e_t \quad (3)$$

Equation 3 can be rearranged as in equation 4 by taking the first difference.

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + e_t \quad (4)$$

In Equation 4, Π is the parameter indicating the long term relation. Thus, the cointegration hypothesis is analyzed through the equation which is $\Pi = \alpha \beta$. So, α and β (pxr) represents a two-dimensional matrix. The matrix α shows the rate of improvement of the deviations from the long-run equilibrium of the variables while β denotes the cointegration vector showing the long-term effects of the variables in the equilibrium relations. The number of cointegration vectors is examined in the framework of Trace Statistics and Maximum-Eigen Statistics. Thus, both tests investigate long term associations by determining how many cointegrated vectors are among the variables.

Trace Statistics can be calculated from the formula indicated in Equation 5. Here, the null hypothesis ($H_0: r \leq m - 1$) is tested against the alternative hypothesis ($H_1: r \geq m$).

$$\lambda_{\text{trace}}(r) = -T \sum_{i=r+1}^m \ln(1 - \lambda_i) \quad (5)$$

Max-Eigen Statistics can be calculated from the formula indicated in Equation 6. Here, the null hypothesis ($H_0: r \leq m - 1$) is tested against the alternative hypothesis ($H_1: r \geq m$).

$$\lambda_{\text{max}}(r, r + 1) = -T \ln(1 - \lambda_{r+1}) \quad (6)$$

If the cointegration relation is found between the variables used in the analysis, then the VECM (Vector Error Correction Model) method should be used when the dynamic effects are examined in the next stage. Accordingly, the models to be used in the causality test developed by Granger (1988) are defined in Equation 7 and 8 below, including the error correction term.

$$\Delta Y_t = \beta_0 + \sum_{i=1}^m \alpha_i \Delta Y_{t-i} + \sum_{k=1}^m \beta_k \Delta X_{t-k} + \lambda_1 \text{ECT}_{t-1} + u_t \quad (7)$$

$$\Delta X_t = \varphi_0 + \sum_{i=1}^m \varphi_i \Delta X_{t-i} + \sum_{k=1}^m \delta_k \Delta Y_{t-k} + \lambda_2 \text{ECT}_{t-1} + v_t \quad (8)$$

In equations, the coefficients of the error correction term (ECT) λ_1 and λ_2 show the rotational speed of X and Y variables to equilibrium relation. Error correction coefficients are expected to be negative and statistically significant. In the framework of Granger causality test, whether the α and δ coefficients in the equations are meaningful is tested by the standard F-test. Accordingly, by equation (7) Y Granger causes X if the null of either $\sum_{k=1}^m \beta_k = 0$ or $\lambda_1 = 0$ is rejected. On the other hand, by equation (8), X Granger causes Y if λ_2 is significant and $\sum_{k=1}^m \delta_k$ are jointly significant.

4 Results and Discussion

Before running the econometric analysis of the model, we test whether time series used in the model are stationary or not. Accordingly, we check whether time series of economic growth rate (EG) and exchange rate (ER) are stationary by using Augmented Dickey Fuller (ADF) and Philips Peron (PP) tests. Table 1 presents the results of unit root tests. Findings show that all variables are not stationary at level. However, by first differentiation all series become stationary since the calculated test statistics exceed the critical values. In conclusion, both economic growth (EG) and exchange rate (ER) series are integrated of the same order at I (1).

Table 1. Results of Unit Root Tests

Variables	ADF (Augmented Dickey Fuller)		PP (Philips Peron)	
	Level	First Difference	Level	First Difference
EG	-3,5311	-6,5466*	-2,4321	-4,5675**
ER	-2,8346	-5,4184*	-1,8778	-3,1134**

Not: * and ** indicate the significance level at 1 % and 5 %, respectively.

Maximum lag length is specified by considering Akaike Information Criterion (1).

Source: Author

After determining that both the series of exchange rate (ER) and economic growth (EG) are integrated of the same order at I (1), we employ Johansen cointegration test in order to investigate the long run relationship between the variables. The results of Johansen Cointegration analysis are presented in Table 3. Results show that the computed value of the both Trace Statistic and Max-Eigen statistic are more than the critical value at 5% level of significance. Therefore, the null hypothesis that there is no co-integrating vector was rejected. Thus, the results of both cointegration test implies that there is long run relationship between exchange rate and economic growth in Turkey.

Table 3 Johansen Cointegration Tests Results

Null Hypothesis	Trace Statistics		Maximum Eigenvalue Statistics	
	Test Statistic	% 5 Critical Value	Test Statistic	% 5 Critical Value
$r = 0$	26.8643	19.7432	20.6784	16.3467
$r \leq 1$	7.5431	8.7854	7.5431	8.7854

Source: Author

Given the long run relationship among the variables, Granger causality test based on the VECM (Vector Error Correction Model) has been employed in order to detect the direction of relation between the variables. The results of Granger causality test are presented in Table-4. According to results, we reject the null hypothesis that exchange rate (ER) does not Granger cause economic growth rate (EG). Thus, findings reveal that causality runs from exchange rate (ER) to economic growth (EG) while the reverse causation is not confirmed.

Table 4 Granger Causality Test

Null Hypothesis	F-Statistic	p-Value	Decision
ER does not Granger cause EG	3.1253*	0.0180	Reject
EG does not Granger cause ER	0.9811	0.4831	Not Reject

Not: * indicates the significance level at 5 %. Maximum lag length is specified by Akaike Information Criterion (1).

Source: Author

Finally, in order to show short-run dynamics between exchange rate and economic growth, the results of VECM estimation are presented in Table 5. The coefficient of error correction term is statistically significant and negative as we expected. Findings also indicated that exchange rate affects economic growth negatively as confirmed by the sign of the related coefficient (ΔER_{t-1}).

Table 5 Estimation Results of Vector Error Correction Model

Variables	Coefficient	t Value	Probability
Constant	0.134**	1.649	0,024
EC_{t-1}	-0.281*	-3,195	0,001
ΔER_{t-1}	-0.133**	-2.078	0.031
ΔEG_{t-1}	0.621*	3,841	0.000

Not: *, ** indicates the significance level at 1% and 5 %, respectively.

Diagnostic Tests: Adj. $R^2 = 0.312$; F test = 4.502 = .025; D.W = 2.034

Source: Author

Overall, empirical results indicated that there is a unidirectional negative causality from exchange rate to economic growth. These finding supports structuralist view asserting that depreciation of local currency have a contractionary impact on economic growth. It seems that depreciation of Turkish Lira restricts imports that create the appropriate conditions for economic growth by providing machinery, equipment and raw materials needed as the production inputs. In terms of policy implementation, empirical findings also give significant insights for the effectiveness of Inflation Targeting Policy adopted in Turkey since 2001. According to this, since the exchange rate is one of the significant determinants of economic growth in Turkey, special importance should be given to exchange rate management under Inflation Targeting Regime. In other words, Inflation Targeting Policy in Turkey should fulfil a difficult task by successfully providing both price and exchange rate stability in the same time.

5 Conclusions

In the literature, there are two basic approach related to transfer mechanism between exchange rate and economic growth. Conventional view argues that rising exchange rate stimulates economic growth via enlarging the volume of net export. Contrarily, Structuralist view claims that there is a negative relationship between exchange rate and economic growth in developing countries in particular. After an increase in exchange rate, in the developing countries that manufacture on the basis of external inputs, the cost of production increases and consequently the economic growth is adversely affected. In the line with the views indicated above, we examine the relationship between exchange rate and economic growth in Turkey using Johansen co-integration and Granger causality tests for the quarterly data from 2002 to 2017.

The findings of Johansen cointegration test show that exchange rate and income are significantly cointegrated in the long run. Estimation results of Granger causality test and Vector Error Correction Model indicated a negative causality relationship from exchange rates to economic growth. Together all of these findings provide an econometric confirmation for structuralist view arguing that the rise in the exchange rate causes a contraction in economic activity. From the policy perspective, instead of completely liberalizing the exchange rate in the framework of inflation targeting strategy adopted since 2011, policy makers in Turkey have to prevent the upside movements in the exchange rate by taking into consideration its negative effect on economic growth.

Acknowledgments

This work was supported by Scientific Research Projects Coordination Unit of Bandırma Onyedi Eylül University. (Project Number: BAP-18-İİBF-1009-038)

References

- Aman, Q., Ullah, I., Khan, M. I., Khan, S. (2013). Linkages between Exchange Rate and Economic Growth in Pakistan. *European Journal of Law and Economics*, vol. 44(1), pp. 157-164.
- Bahmani-Oskooee, M., Chomsisengphet, S., Kandil, M. (2002). Are Devaluations Contractionary in Asia. *Journal of Post Keynesian Economics*, vol. 25(1), pp. 69-81.
- Bird, G., Rajan, R. S. (2004). Does Devaluation Lead to Economic Recovery or Economic Contraction? Theory and Policy with Reference to Thailand. *Journal of International Development*, vol. 16, pp. 141-156.
- Blecker, R. A., Razmi, A. (2008). The Fallacy of Composition and Contractionary Devaluations: Output Effects of Real Exchange Rate Shocks in Semi Industrialised Countries. *Cambridge Journal of Economics*, vol. 32(1), pp. 83-109.
- Chen, J. (2012). Real Exchange Rate and Economic Growth: Evidence from Chinese Provincial data. *PSE Working Papers*, pp. 127.
- Çelik, T., Çelik B., Barak, D. (2017). Real Exchange Rate and Economic Growth Relationship in Transition Economies. *Suleyman Demirel University, The Journal of Faculty of Economics and Administrative Sciences*, vol. 22(3), pp. 877-890.
- Di Nino, V., Eichengreen, B., Sbracia, M., (2011). Real Exchange Rates, Trade, and Growth: Italy 1861– 2011. *Banca d'Italia Economic History Working Papers*, no. 10.
- Dickey, D.A., Fuller, W. A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica*, vol. 49(4), pp. 1057-1072.
- Domacı, İ. (1997). Are Devaluations Contractionary? Evidence from Turkey. *Journal of Economic Development*, vol. 22(2), pp. 145-163.
- Galindo, A., Izquierdo, A., Montero, J., (2005). Real Exchange Rates, Dollarization and Industrial Employment in Latin America. *Banco de España Working Paper*, no. 0601.

- Granger, C. W. J. (1988). Some Recent Developments in a Concept of Causality. *Journal of Econometrics*, vol. 39(1-2), pp. 199-211.
- Hallwood, C. P., Macdonald R. (2003). *International Money and Finance*. Blackwell Publishing. ISBN: 0-631-20461-X.
- Johansen, S., Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration with Application to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, vol. 52, pp. 169-210.
- Keller, W. (2004). International Technology Diffusion. *Journal of Economic Literature*, vol. XLII, pp. 752-782.
- Lee, J. W. (1995). Capital Goods Imports and Long-run Growth. *Journal of Development Economics*, vol. 48, pp. 91-110
- Habib, M. M., Mileva, E., Stracca, L. (2017). The Real Exchange Rate and Economic Growth: Revisiting the case using External Instruments. *Journal of International Money and Finance*, vol. 73, pp. 386-398.
- Mazumdar, J. (2001). Imported Machinery and Growth in LDCs. *Journal of Development Economics*, vol. 65, pp. 209-24.
- Narayan, P. K., Narayan, S. (2007). Is Devaluation Expansionary or Contractionary? Empirical Evidence from Fiji. *Applied Economics*, vol. 39, pp. 2589-2598.
- Phillips, P. C. B., Perron, P. (1988). Testing for a Unit Root in Time Series Regression. *Biometrika*, vol. 75, pp. 335-346.
- Rodrik, D. (2008). The real exchange rate and economic growth. *Brookings Papers on Economic Activity*, vol. 2, pp. 365-412.
- Vaz, H. P., Baer, W. (2014). Real Exchange Rate and Manufacturing Growth in Latin America. *Latin American Economic Review*, vol. 23(2), pp. 1-17.
- Yihesis, Z. (2006). The Effects of Devaluation on Aggregate Output: Empirical Evidence from Africa. *International Review of Applied Economics*, vol. 20(1), pp. 21-45.

The Effect of Bank Credit on the Current Account Balance in Turkey

Özcan Karahan¹, Metehan Yılğör², Hakan Öndes³

¹ Bandırma Onyedi Eylül University
Faculty of Economics and Political Sciences, Economics Department
Merkez Yerleşkesi, 10200, Bandırma-Balıkesir, Turkey
E-mail: okarahan@bandirma.edu.tr

² Bandırma Onyedi Eylül University
Faculty of Economics and Political Sciences, Econometrics Department
Merkez Yerleşkesi, 10200, Bandırma-Balıkesir, Turkey;
E-mail: myilgor@bandirma.edu.tr

³ Bandırma Onyedi Eylül University
Faculty of Economics and Political Sciences, Econometrics Department
Merkez Yerleşkesi, 10200, Bandırma-Balıkesir, Turkey
E-mail: hondes@bandirma.edu.tr

Abstract: Like another developing country, one of the most important problems in Turkish economy is the large current account imbalance which continues permanently. Past experiences in the Turkish economy indicated that persistent large current account imbalances make financial system more fragile and cause serious currency crises. Therefore, examining the determinants of current account deficit in Turkey becomes a significant research topic. Accordingly, this study aims to analyse the impact of bank credit expansion on current account balance in Turkey. Covering the quarterly data between 2004 and 2017 the relationship between bank credit and current account balance has been investigated in the long run and the short run by ARDL Model. Empirical results show that there is a causal relationship from credit growth to current account deficit. It seems that credit expansion has been one of the leading reasons behind the growing current account deficits in Turkey. Thus, the results indicate that policy-makers in Turkey should take into account the credit expansion while keeping the current account balance as the primary objective to provide financial system soundness and economic stability.

Keywords: bank credit, current account deficit, ARDL model

JEL codes: E51, F32, C22

1 Introduction

Along with the liberalization process of the 1980s, real and financial economic relations among the countries have increased. In this process, the current account balance which demonstrates domestic residents' transactions with foreigners in the goods markets had been critical for the developing economies from various aspects. Even if developing countries have the opportunity to finance current account deficits by attracting foreign capital flows from international financial markets, national economies with high levels of current account deficits in the turbulent global market environment have become more vulnerable to external economic conditions. For this reason, high level of current account deficit has been accepted as an indicator that show the imbalance in the economy and country's risk increase.

Thus, the fight against the current account deficit can be seen as one of the main policy objectives for developing countries. In this context, studies aiming to determine the dynamics of current account deficits have begun to take an important place in the literature. Economists have identified many factors that cause the current account deficit in developing countries. However, in recent years, economists have focused on the credit expansion as the basic dynamic of current account deficit. Accordingly, expansion of bank credit leads current account balance via increasing total consumption. Thus, total credit volume in banking sector regarded as a driving force behind the growth of the current account deficit. Therefore, economic policies towards controlling the volume of bank credit have crucial importance for developing countries with high current account deficits.

Turkey is also among the countries facing with the problem of current account deficit. Indeed, the current account deficit for Turkish economy was a chronic macroeconomic problem which had generated financial instability and economic crisis in the past. Therefore, changes in the current account deficit and its determinants are on the top topics of agenda in Turkish economy today. Accordingly, this study examined the dynamics determining the current account balance focusing on the role of credit expansion in Turkey. More specifically, the aim of our study is to explore the impact of credit expansion in Turkey on current account balance during the period of 2004- 2017 by employing ARDL model. The paper proceeds as follows: Section 2 discusses the related literature briefly. Section 3 presents the data, econometric methodology and results. Final section concludes and makes some policy implications.

2 Literature

Looking at the literature, it seems that one of the most important macroeconomic problems in developing countries is current account deficit. It also seems that credit volume has been shown among the basic determinants of current account deficit by most of the economists. It can be theoretically asserted that an increase in bank credit would have an unbalancing effect on the current account deficit via stimulating import in developing countries. Accordingly, bank credits increase total domestic consumption, which results in increasing volume of imported consumption and investment goods.

Credit expansion or an increase in total domestic credit volume means that economic actors within the country have an additional income and purchasing power. This additional purchasing power is expected to increase both domestic demand and external demand since it is almost impossible to assess all of the consumer demand within the country. The increase in consumption demand for the foreign market directly increases the current account deficit. The increase in demand for the domestic market also leads to a current account deficit indirectly by increasing the imports of investment goods such as capital and intermediary goods in developing countries. As is known, the production structure in developing countries is overly dependent on the import of foreign intermediate and machinery equipment. That means firms in developing countries produce on the basis of imported inputs. For this reason, the increase in domestic demand due to the expansion of bank credits and the start of additional production of companies cause the increase of imported input production, which results in the increase of the current account deficit.

There are numerous empirical studies analysed whether there is a causal relationship between bank credit and current account deficits. It seems that total credit volume in banking sector is a driving force behind the growth of the current account deficit. Brissimis et al. (2012) studied the main macroeconomic factors that shaped current account development in Greece over the period from 1960 to 2007. They found that credit growth was pivotal in explaining the fall of the private saving rate and thus a factor deteriorating of the current account. Ekinci et al. (2015) analysed the determinants of the current account balance for the annual dataset covering the period from 1991 to 2011 in 49 countries including industrial and developing ones. They employed generalized method of moments (GMM) procedure in the framework of dynamic panel data analysis and reported a significant deterioration in the current account balance in case of an increase in the credit growth. The acceleration of loan growth has a deteriorating effect on current account balance especially in emerging countries. Buyukkarabacak and Krause (2009) investigated the impact of household and firm credit on current account deficit using data between 1990 and 2011 in 18 emerging economies. Employing panel data analysis, it was concluded that household credit is negatively but firm credit is positively correlated with the trade balance. In other words, consumer credit and producer credit have sharply different impacts on the trade balance.

Concerning with the case of Turkey, Göçer, İ. (2013) investigated the relationship between total domestic credit and current account deficit in Turkey. The results of cointegration test with multiple structural breaks using quarterly data over the period 1992–2013 determined that an increase in the domestic credit volume is a factor in increasing the

current account deficit. Demirhan (2014) analysed the effect of credit growth on current account deficit using quarterly data ranging from 1998 to 2015. Empirical results of ARDL model showed that credit growth have a significant impact on current account deficit in the short run and the long run. Thus, it was concluded that credit growth is taken into consideration as policy instruments improving current account balance in Turkey. Soydan (2016) empirically analyzed the relationship between current account balances and domestic credit dynamics in the case of Turkey. The results of ARDL bounds testing methodology showed the causality between domestic credit and external balance. Accordingly, he concluded that policymakers should designed a policy towards bring credit growth down in order to reduction in current account deficit. Karahan and Uslu (2016) investigated the relationship between credit by which commercial bank to private sector and current account deficit covering the period of 2005-2015. Employing ARDL model, it is asserted that credit volume is statistical significant and positively affects current account deficit in the short and long run. Therefore policymakers in Turkey should slow down credit volume in response to current account deficit in order to ensure financial stability.

Looking at the literature it seems that some studies decompose bank credit while examining the impact on external balance in Turkey. Telatar (2011), using the quarterly data between 2003 and 2010, examined the impact of different bank credit on current account deficit. He found that there is no significant causality relation to the current account from the total loans but there is a positive causality relation to the current account from the consumer loans. In other words, he showed that consumer credits, rather than total credits, contribute to current account deficit. Turgutlu (2014) also decomposed consumer loans into sub-categories as real estate loans, vehicle loans and other loans to investigate their individual effects on the current account balance of Turkey over the period 2000-2013. The results of ARDL model indicated that real estate loans and other loans negatively affected the current account balance. Alioğulları et al. (2015) investigated the relationship between consumer and commercial loan growths and current account deficit in Turkey. Regression analysis using quarterly data between 2003 and 2015 revealed that consumer loan growth negatively and statistically significantly affects current account balance while commercial loan growth has no statistically significant effect. Finally, Dücan (2016) investigated the impact of the increase in consumer credit on current account deficit using quarterly data covering the period between 2009 and 2015. Granger causality test and impulse response analysis and variance decomposition based on the VAR model were carried out. Empirical findings showed that the increase in consumer loans seems to be quite high share in the expansion of current account deficit.

Contrary to studies indicated above, some studies found no relationship between bank credit and externa balance in Turkey. For example, Gacaner and Saygılı (2014) used quarterly data for the period of 1998-2013 to identify the determinants of the current account deficit in Turkey. When the variables affecting the current account deficit are evaluated together, they determined that the effects of variables representing monetary aggregates like bank credit are weak. Thus, their results showed that the limitations on the loans are not enough to reduce current account deficit problem. Akçayır and Albeni (2016) examined the link between the volume of loans and the current account deficit in Turkey. Conducting Toda-Yamamoto test and ARDL Model for quarterly data set covering the period between 1992 and 2014, they found that the impact of bank credit on current account deficit is very weak. Therefore, they argued that it is impossible to think of the total domestic credit volume as the single most powerful cause of the current deficit in Turkey. Thus, it is not anticipated that policies towards restriction of bank credit expansion will be effective over the elements that increase current account deficit.

3 Data, Methodology and Empirical Results

The aim of this section is to empirically analyse the relationship between credit expansion and the current account deficit in Turkey. We use quarterly data covering the period 2004-Q1 and 2017-Q4. The amount of bank credit consists of all kinds of loan given to firms and household except credit cards. The current account deficit (CAD) and total bank credit (BC) variables used in the model is obtained as ration of current account deficit and bank credit

data to Gross Domestic Product (GDP). In addition, the logarithms of the series were taken and each data are shown as LBC and LCAD. All of the data set is compiled from the Electronic Data Distribution System (EDDS) in Central Bank of the Republic of Turkey (CBRT).

Empirical analysis begins by conducting the unit root tests such as ADF and PP in order to check the stationary status of the variables. Later, the relationship between the series of bank credit and current account balance has been examined by using the autoregressive distributed lag (ARDL) model popularized by Pesaran, et al. (1996), Pesaran (1997) and Pesaran and Shin (1999). ARDL model does not impose a restrictive assumption that all the variables under study must be integrated of the same order. This model also allows us to get consistent and robust results both for the long-run and short-run relationship among the variables even if the sample size is small. In the framework of ARDL model we follow three-step procedure.

Firstly, cointegration relationship between the series of bank credit and current account balance has been examined by using Bond Test. In the framework of bounds test, calculated F-statistics is compared with the critical value tabulated by Pesaran (1997) and Pesaran et al. (2001). If F-statistics exceeds the upper critical value, the null hypothesis of a no long-run relationship can be rejected. If the test statistic falls below a lower critical value, the null hypothesis is not rejected. However, if the test statistic falls between these two bounds, the result is inconclusive. When the order of integration of all the variables is I (1), the decision is made based on the upper bound. If all the variables are I (0), then the decision is made based on the lower bound.

In the second step, if there is evidence of a cointegration among the variables, the long-run model indicated in Equation 1 is estimated. It is expected that coefficient of bank credit (λ) is positive and statistically significant.

$$LCAD_t = \delta_1 + \sum_{i=1}^n \beta_i LCAD_{t-i} + \sum_{i=1}^n \lambda_i LBC_{t-i} + \varepsilon_t \quad (1)$$

In the third step, based on the finding related to a long run relationship, error correction model (ECM), which indicates the speed of adjustment back to long-run equilibrium after a short-run disturbance is estimated. The standard ECM involves estimating the model indicated in Equation 2. It is expected that coefficient of error correction term (ECT) is negative and statistically significant

$$\Delta LCAD_t = \gamma_1 + \theta_0 ECT_{t-1} + \sum_{i=1}^n \alpha_i \Delta LCAD_{t-i} + \sum_{i=1}^n \alpha_i \Delta LBC_{t-i} + \varepsilon_t \quad (2)$$

Unit Root Test

Firstly, to determine the order of integration for each variable we use the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests. The first step of the empirical methodology is finding the order of integrations of the data. Accordingly, in order to indicate the stationary statute of data set related to bank credit (LBC) and current account deficit (LCAD) we perform Augmented Dickey Fuller (ADF) and Phillips Peron (PP) unit root tests. The results of the Augmented Dickey-Fuller and Phillip Perron tests are presented in Table-1. Bank credit (LBC) is integrated to the order of one I (1), while the current account deficit (LCAD) is also integrated to the order of one I (1). Findings show that all variables are not stationary at level but both series become stationary after taking their first difference. Thus, unit root test results show that all time series in the model have same order I (1).

Table 1 Results of Unit Root Tests

Variables	ADF (Augmented Dickey Fuller)		PP (Philips Peron)	
	Level	First Difference	Level	First Difference
LBC	-1,274	-3,332**	-1,676	-2,679*
LCAD	-2,159	-5,488***	-2,028	-2,242*

Note: *, ** and *** denote statistical significance at the 10 %, 5 % and 1 % levels, respectively. Maximum lag length is specified by considering Akaike Information Criterion (2).

Source: Authors

Cointegration Tests

In this section we employ cointegration tests which are the standard tools in order to investigate the linear combination of time series variables. In the framework of ARDL model, bounds test is applied to indicate whether bank credit (LBC) and current account deficit (LCAD) have a long run relationship or not.

In the framework of bounds test for co-integration, we firstly determine lag order as 5 based on Akaike Information Criterion. Accordingly, bounds test is employed and the results are shown in Table-2. As can be seen from the Table calculated F-statistic (6.333) is higher than the upper bound critical value at a 5% level of significance (4.390) as reported by Pesaran et al. (2001). This implies that the null hypothesis of no cointegration is rejected at 5%. Therefore, there is a cointegrating relationship among the bank credit and current account deficit. In other words, the result of the bounds test indicates that there is a stable long-run relationship between the bank credit and current account balance.

Table 2 ARDL Bound Test Results

F statistics (k=1, n=55)	Critical Values					
	1%		5%		10%	
4,90	I (0)	I (I)	I (0)	I (I)	I (0)	I (I)
	3.143	3.670	3.790	4.190	5.377	6.047
Diagnostic Test	R ²	Adj. R ²	LM Test	BP	JB	Wald
	0.81	0.75	2.45 (0.10)	1.05 (0.42)	1.07 (0.58)	4.90

Note: k is the number of independent variables while N indicates the number of observations. Critical values are taken from Narayan (2005).

Source: Authors

Results of Long Run Estimation

After indicating the presence of cointegration among the variables, in this part of study we estimated the coefficients indicated the long run relationship between bank credit and current account deficit. The empirical results of the long-run model obtained by ARDL (6,5) based on Akaike Information Criterion are presented in Table-3. The impact of the bank credit on the current account deficit is positive and statistically significant. The results indicate that the bank credit is an important determinant of current account deficit. Every 1% increase in bank credit yields average 0.231% deterioration in the current account balance. Thus, the results confirm the theory asserting that a rise in bank credit increases the total consumption and will therefore increase imported consumption and investment goods and deteriorate the current account balance.

To ascertain the goodness of fit of the ARDL model, the results of diagnostic and stability tests also have been presented in Table 3. Test results of LM, Breusch-Pagan and Jarque-Bera indicate that there is no problem of the serial correlation, heteroscedasticity, normality, associated with the model.

Table 3 Estimated Long-Run Coefficients for ARDL (6,5)

Variables	Coefficients	Prob.
LCAD(-1)	1.955***	0.000
LCAD(-2)	-2.087***	0.000
LCAD(-3)	1.653***	0.000
LCAD(-4)	-1.179**	0.010
LCAD(-5)	0.686**	0.044
LCAD(-6)	-0.196	0.191
LBC	0.231**	0.038
LBC(-1)	-0.634**	0.039
LBC(-2)	1.085*	0.077
LBC(-3)	-1.213*	0.086
LBC(-4)	1.083*	0.099
LBC(-5)	-0.547**	0.030
C		
Long Term Coefficients		
C	0.258**	0.035
BC	0.231**	0.040
Diagnostic Test		
R ²	0.95	
Adj. R ²	0.94	
LM test	2.02 [0.16]	
Breusch-Pagan	0.95 [0.50]	
Jarque-Bera	1.70 [0.42]	

Note: *, ** and *** denote statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Source: Authors

Results of Short Run Estimation

The results of the ECM obtained by ARDL (5,6) based on Akaike Information Criterion are presented in Table-4. Estimated coefficient of bank credit is positive and statistically significant. Every 1% increase in bank credit yields average 0.212% deterioration in the current account balance. It seems that the magnitude of positive impact of bank credit on the current account deficit is smaller than that of the long-run impact (0.231%). This finding indicates that the impact of change in bank credit on current account balance is stronger in the long run compared to short run.

Error correction term (ECT₋₁) is one lagged value of the residuals from long-run ARDL model and the coefficient of it is the speed of adjustment towards long term equilibrium path. The coefficient of the lagged error term (ECT₋₁) is negative and highly statistically significant as we expected. The significance of error correction term shows the causality in at least one direction. The coefficient of -0.579 indicates the rate of convergence to equilibrium, which implies that deviation from the long-term equilibrium is corrected by 57.90 % over each quarter. We apply a number of diagnostic tests to ascertain the goodness of fit of the error correction model. Findings of LM and Breusch-Pagan confirm that there is no serial correlation and heteroskedasticity, respectively. The model also passes the Jarque-Bera normality test which suggests that the errors are normally distributed.

Summing up the empirical results, it can be inferred that there is reasonable evidence depicting both positive long-run and short-run relationship between the bank credit and current account deficit in the case of Turkey. In other words, results of ARDL model indicate that the credit volume of Turkish Economy is statistical significant and positively affects current account deficit in the short and long run. The policy implication is that credit growth is taken into consideration as policy instruments improving current account balance and hence macroeconomic stability in Turkey. For example difficulties in the current account balance can be corrected through monetary policies restricting the volume of bank credit.

Table 4 Estimated Error Correction Model

Variables	Coefficients	Prob.
Δ LCAD(-1)	1.615***	0.000
Δ LCAD(-2)	-1.875***	0.000
Δ LCAD(-3)	1.453***	0.000
Δ LCAD(-4)	-1.294***	0.000
Δ LCAD(-5)	0.795***	0.004
Δ LCAD(-6)	-0.450***	0.002
Δ LBC	0.212**	0.038
Δ LBC(-1)	-0.332**	0.044
Δ LBC(-2)	0.652**	0.029
Δ LBC(-3)	0.504**	0.024
Δ LBC(-4)	0.414	0.107
ECT(-1)	-0.579*	0.084
C	-0.008	0.353
Diagnostic Test		
R ²	0.82	
Adj. R ²	0.76	
LM Test	1.44 [0.25]	
Breusch-Pagan	1.63 [0.12]	
Jarque-Bera	1.32 [0.51]	

Note: *, ** and *** denote statistical significance at the 10 %, 5 % and 1 % levels, respectively.

Source: Authors

4 Conclusions

Continuity high current account deficit has been one of the crucial economic problems in Turkey from past to now. Namely, an increase in current account deficit has been considered as significant factor raising country risk and leading to economic crisis. Therefore, it is crucial to indicate the dynamics of current account imbalance for Turkish economic agenda. Accordingly, this article is an attempt to examine the short and long-run relationship between the bank credit and current account balance in the case of Turkish economy. The autoregressive distributed lag (ARDL) model is applied to quarterly data for the period 2004 to 2017 in order to investigate whether a causal relationship exists between the bank credit and current account balance.

The result of the bounds test indicates that there is a stable long-run relationship between the bank credit and current account balance. The estimated coefficients in the short run and long run ARDL models show that the volume of bank credit is positively related to the current account deficit. Thus, the results provide an evidence that bank credit play a stronger role in determining the behaviour of the current account deficit in Turkey. This finding also shows that unbalancing impact of bank credit expansion on current account is crucial factor determining macro-economic risks in Turkey. Thus, management of the volume of bank credit is crucial for designing policies aimed at macroeconomic stability. That means the monetary policy framework of Central Bank of the Republic of Turkey (CBRT) should take into account the volume of bank credit while keeping the current account balance and macroeconomic stability together.

References

- Akçayır, Ö., Albeni, M. (2016). Impact of Credit Expansion on the Current Account Deficit in Turkey: Bound Test Approach. *Çankırı Karatekin University, Journal of The Faculty of Economics and Administrative Sciences*, vol. 6(1), pp. 557-583.
- Alioğulları, H. Z., Başkaya, Y. S., Bulut, Y. E. and Kılınç, M. (2015). The Relationship of Consumer and Commercial Loans with Current Account Deficit in Turkey. *Research Notes In Economics*, no: 2015-19/17.

- Brissimis, S. N., Hondroyannis, G., Papazoglou, C., Tsaveas, N. T., Vasardani, M. A. (2012). Current Account Determinants and External Sustainability in Periods of Structural Change. *Economic Change and Restructuring*, vol. 45, pp. 71-95.
- Buyukkarabacak, B., Krause, S. (2009). Studying the Effects of Household and Firm Credit on the Trade Balance: The Composition of Funds Matters, *Economic Inquiry*, vol. 47, pp. 653-666.
- Demirhan, B. (2014). The Impact of Credit Growth and Real Exchange Rate Appreciation on Current Account Deficit in Turkey: ARDL Bounds Testing Approach. *Journal of International Trade, Finance and Logistics*, vol. 1(1), pp. 79-92.
- Dücan, E., Polat, A. M., Balcioğlu, E. (2016). The Relationship between Turkey's Consumer Credits and Current Account Deficit as an Example of Consumer Society. *The Journal of Politics, Economics and Management*, vol. 4(1), pp. 161-188.
- Ekinci, M. F., Erdem, F. P., Kiling, Z., (2015). Credit Growth, Current Account and Financial Depth. *Applied Economics*, vol. 47(17), pp. 1809-1821.
- Gacener Atış, A., Saygılı, F. (2014). Determinants of Current Account Deficit in Turkey: Empirical Analysis. *Sosyoekonomi*, vol. 2014-1, pp. 87-103.
- Göçer, İ., Mercan M., Peker, O. (2013). The Impact of Increase of the Volume of Credit on Current Account Deficit: Analysis of Cointegration and Multiple Structural Breaks. *Ekonometri and İstatistik*, vol. 18, pp. 1-17.
- Karahan., P., Uslu, N. Ç. (2016). The Relationship between Current Account Deficit and Volume of Credit: Dynamic Analysis for Turkey. *EconWorld Working Paper Series*, no. 2016-007, pp. 1-10.
- Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied Economics*, vol. 37(17), pp. 1979-1990.
- Pesaran, M. H., Shin, Y., Smith, R. J. (1996). Testing for the 'Existence of a Long-Run Relationship. *University of Cambridge. Department of Applied Economics Working Paper*, no. 9622.
- Pesaran, M. H. (1997). The Role of Economic Theory in Modelling the Long-Run. *The Economic Journal*, vol. 107, pp. 178-191.
- Pesaran, M. H., Shin, Y. (1999). An Autoregressive Distributed Lag Modeling Approach to Cointegration Analysis, In: Strom, S. Holly, A. Diamond, P., eds., *Centennial Volume of Rangar Frisch*. Cambridge: Cambridge University Press.
- Pesaran, M. H., Shin, Y., Smith, R. J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics*, vol. 16(3), pp. 289-326.
- Soydan, A. (2016). Does Credit Growth Cause Current Account deficits? Evidence from Turkey. *Advances in Economics and Business*, vol. 4(2), pp. 102-116.
- Telatar, E. (2011). Determinant of Current Account Deficit in Turkey and the Relationship between Bank Credit and Current Account Deficit. *The Journal of Bankers*, vol. 78, pp. 22-34.
- Turgutlu, E. (2014). Current Account Balance Implications of Consumer loans: The case of Turkey. *International Journal of Applied Economics*, vol. 11(2), pp. 55-64.

Relations between IFRS Adoption and Financial and Non-financial Measures of Economic Entities, Empirical Results from the Selected Countries of Western Europe

Marcin Kędzior¹, Dorota Kędzior²

¹ Cracow University of Economics
Faculty of Finance and Law, Financial Accounting Department
ul. Rakowicka 27, 31-510 Cracow, Poland
E-mail: kedziorm@uek.krakow.pl

² Cracow University of Economics
Faculty of Finance and Law, Corporate Finance Department
ul. Rakowicka 27, 31-510 Cracow, Poland
E-mail: kedziord@uek.krakow.pl

Abstract: *The aim of the article was to analyze the relationship between the application of IFRS by economic entities and financial and non-financial measures of enterprises in the selected countries of Western Europe. 461 companies from Western European countries were analyzed. The article discusses the issues of preparing financial statements according to IFRS. The subject of the detailed analysis were correlations between the IFRS application and profitability, liquidity ratio, assets turnover, investment intensity, total debt ratio, company size, company growth, international activity, market share and industry concentration. The higher level of risk, lower liquidity, lower turnover of assets, higher capital intensity, higher company size, age of the business unit, broader international operations and higher market shares in companies applying IFRS in selected countries of Western Europe were verified empirically.*

Keywords: *IFRS adoption, European Union, financial ratios, non-financial ratio, accounting harmonization*

JEL codes: *M41, M42, M21, L6, L2*

1 Introduction

International Financial Reporting Standards have been globally recognized and accepted in accounting. They should be considered as the most mature form of harmonization of local accounting standards applied in particular countries, and they have been implemented in over 120 countries. The scope of their application varies significantly, however they are most commonly applied on stock exchanges. Within the area of the EU, all listed companies preparing consolidated financial statements are obliged to comply with their standards. In some countries, it is required to apply them in all entities, both listed and unlisted (Bulgaria), whilst in other countries they are allowed, yet not mandatory for the financial reports of unconsolidated listed companies (Great Britain), or finally in some other countries their application for the mentioned above companies is prohibited (Hungary, Sweden, Spain). Within the confines of the EU, voluntary use of standards in the countries of Western Europe has been increasing, even though the dynamics of that increase has somehow slowed down (Kędzior, 2015).

The application of IFRS is beneficial for many participants in the market. The standards enhance the quality of financial reporting; it is more precise, submitted on time, it better protects the interests of minority investors, largely eliminates disparities between local accounting standards, lowers the cost of financial information for the investors (Ball, 2006). Nonetheless, the application of IFRS proves to be costly for many entities as it requires advanced training sessions, and numerous enterprises encounter problems in the practical application of standards. In many cases, intensive investment in the area of IT is prerequisite (Kim et al., 2012). Numerous research papers have shown the conducive impact of IFRS on the cost of capital, risk (Daske, 2006; Daske et al., 2008), profitability, liquidity (Persakis and Iatridis, 2017; Grabiński and Kędzior, 2006), minimizing earnings management (André et al., 2012), and alike. This paper aims at analyzing the

dependencies between IFRS application by the economic entities and the chosen financial and non-financial company evaluation ratios in the selected countries of Western Europe. The analysis will focus on the relationships between IFRS application and profitability, liquidity ratio, assets turnover, investment intensity, total debt ratio, company size, company growth, company age, international activity, market share and industry concentration. The analysis of relationships between asset turnover, market share, industry concentration and IFRS should be considered as a novelty in the literature on that subject.

2 The application of IFRS versus financial and non-financial gauges applied by economic entities

In literature, various dependencies between the application of IFRS and the selected financial and non-financial factors were analyzed. Bessieux-Ollier and Walliser (2012) considered the size of the company, book value of fixed assets versus total assets, or sectorial affiliation. Bova and Pereira (2012) empirically verified indebtedness, company size, ROE, the percentage of shares held by foreign investors, the number of companies in the industry, book-to-market ratio, dividend yield. In turn, Gassen and Sellhorn (2006) analyzed the dependencies between IFRS and international exposure, company size, dispersion of ownership and recent IPOs. Renders and Gaeremynck (2007) scrutinized microeconomic factors and country level factors. This paper will focus on profitability, liquidity ratio, assets turnover, investment intensity, total debt ratio, company size, company growth, company age, international activity, market share and industry concentration (compare: Gupta et al., 2017).

Apparently the companies that apply IFRS are characterized by higher profitability (Pichler et al., 2018). Business entities that use IFRS should be considered as entities with lower risk, a larger scope of accounting disclosures, hence also often a lower cost of capital (Daske, 2006; Daske et al., 2008; Jaruga et al., 2007; compare: Cuijpers and Buijink, 2005). In most cases, the application of IFRS translates into higher quality of financial reporting in comparison to the local standards. For that reason, the entities applying IFRS can expect a better access to external financing (Kędzior, 2012; similarly, Grabiński et al, 2013). On the other hand, it should be noted that earnings smoothing is made more difficult by the application of high quality reporting standards (IFRS). Consequently, it is likely that companies demonstrating high, or consistently high profitability level will decide to apply IFRS (André et al., 2012). In line with the theory of political costs, highly profitable business entities should account for their high profitability by additional disclosure and special transparency which is feasible with the application of IFRS.

Companies which show higher levels of risk will be more prone to apply IFRS. This is primarily attributable to the necessity of lowering the corporate risk through the application of high quality financial reporting. Higher quality of such reporting allows individual investors to compete with the institutional investors on capital markets, particularly the less informed investors. Financial reporting according to IFRS reduces the cost and risk of information for investors, hence they may require lower rate of return on stock (Ball, 2006). The application of IFRS facilitates risk assessment for the investors (Fijałkowska and Jaruga-Baranowska, 2007) and also conveys more information e.g. on the investment risk (Adamik-Citak, 2011).

Low liquidity companies will strive for voluntary application of IFRS. Excessively low liquidity ratios increase the risk for a company and they may even lead to bankruptcy (Maślanka, 2012; Maślanka, Mazur-Maślanka, 2017). The application of high quality accounting standards (IFRS) may become the way for lowering the risk. IFRS ensure better information about company's liquidity relative to local standards (Adamik-Citak, 2011). In view of Grabiński and Kędzior (2007) those companies that apply IFRS show lower liquidity level. They can afford it due to lower risk. However, in the opinion of the authors those differences are negligible. Large companies showing excess liquidity do not mostly require external capital, hence the application of global accounting standards is not for them of major importance.

Companies characterized by high operational efficiency will be less likely to apply IFRS. The higher asset turnover, the more efficient use of assets which may translate into higher profitability of an entity (Okwo et al., 2012). It seems that those companies which display higher operational efficiency are more likely to obtain external financing at a lower cost. By this token, they will not strive to implement IFRS at all cost. Companies characterized by high asset turnover are mostly smaller entities which do not possess the resources necessary for IFRS implementation (Chi and Padgett, 2006).

High capital intensity is to be found most often in those companies which practice local accounting standards rather than global solutions such as IFRS (compare: Renders and Gaeremynck, 2007). Capital intensity is to be understood as the share of fixed assets in the balance sheet total. The companies with a high share of fixed assets are considered to be relatively safe; their operation is predictable, and book value closer to the market value. In most cases, fixed assets do not stand for higher disclosure since their value is relatively stable and it does not involve "buying options on future" (Hope et al., 2006; Bessieux-Ollier and Walliser, 2012). In addition, oversight of long term fixed assets is not as important as a large share of current assets. Hence, the application of IFRS in these entities is less likely (Dumontier and Raffournier, 1998; André et al., 2012).

Indebted companies are more likely to disclose financial and non-financial information. Higher level of risk requires more disclosure to lessen the informative asymmetry between people who are outside and inside the company. In this way it is possible to lower the cost of additional oversight and agency costs to be borne by the owners. Higher cost of capital for the indebted companies may be lowered by voluntary disclosure of additional information (IFRS) (compare: Li, 2010). Economic entities encumbered with higher risk (high indebtedness) are more willing to implement IFRS to mitigate the cost of capital. High quality accounting standards may be conducive for forming proper relations between the owners and creditors. Credit terms are more likely to be complied with and less prone to manipulation when high quality, rigorous accounting standards (IFRS) are being implemented. By the same token, monitoring the company from the perspective of creditors as well as the owners will be more efficient once high quality accounting standards are up and running.

Large companies are more prone to apply IFRS since the costs of their implementation are relatively lower for large entities (Bessieux-Ollier and Walliser, 2012). Large entities are obliged to disclose more financial information, hence their clear preference for IFRS. The cost of disclosing successive information is declining as that cost is spread over a bigger amount of sold products or services (Cuijpers and Buijink, 2005). Operating in line with the theory of political costs, large entities should disclose greater volume of financial information. Large entities are often financed with external capital and that is why they are concerned about securities exchanges reactions and they prefer the accounting standards that are common there (IFRS). By disclosing more information large entities do not worry about losing their competitive advantage. In conclusion, large entities, stable on the market, should apply high quality (credible), generally accepted accounting standards (compare: Gassen and Sellhorn, 2006).

Companies with a relatively high growth potential are more likely to apply IFRS. For obvious reasons, those companies will be more dependent on the external capital to finance their dynamic growth. One of the prerequisites for the acquisition of capital at lower cost will be decreasing information asymmetry with the increased disclosure guaranteed by IFRS. IFRS warrant high quality of financial reporting (Fitó et al., 2012). The external investors will become more interested in financing a company with a high growth potential once the risk of financial reporting is mitigated, and information asymmetry contained (André et al., 2012).

Again, the dependencies between the age of a company and application of IFRS are not quite clear. Younger companies are, as a rule, more flexible, and they are characterized by greater development potential or the management more open to changes. Greater development potential translates into a greater demand for the external capital (Bassemir, 2012). It is necessary to show that the conducted activity and the financial performance

are credible, hence the application of IFRS seems more likely. Nonetheless, the process of their application is complex, costly and time consuming, and it calls for qualified manpower and expertise. Quite often, advanced training courses allowing proper implementation of IFRS are a must, and they are necessary for older companies. Such companies are, as a rule, larger entities, well established on the market, and simply required to apply high quality financial reporting (Şenyiğit, 2014). It seems natural that the above attitude will prevail and older companies will more eager to apply IFRS.

The companies engaged in the international activity will be more likely to apply IFRS since they are more accepted on capital markets. Quite frequently, the companies involved internationally are required to produce financial reports for the local markets. Their cost can be lowered with a uniform application of consistent, standardized accounting standards (IFRS). By the same token, the cost of auditing financial reports may be also mitigated. What is more, IFRS reports provide wider information on changing currency exchange rates which are crucial for international companies (Adamik-Citak, 2011). International operations mean that international investors can also invest in enterprises. It is also more common to hire Board or Supervisory Board members from abroad. Due to their little knowledge about local accounting standards they will prefer globally recognized, high quality accounting standards represented by IFRS (Francis et al., 2008; Bova and Pereira, 2012).

The companies which have a large share in the market are called industry leaders in many categories. This phenomenon concerns the competitive advantage related to operating, financial and investment activities. The largest companies on the market are concerned about their image in the eyes of many stakeholders, so they will be especially interested in the application of widely recognized and reputable accounting standards (IFRS). The companies which have a large share in the market are characterized by high innovation and susceptibility to change in many areas (e.g. replacing local standards with IFRS) (Goddard et al., 2005). As large economic entities they will be more likely to use IFRS. It should also be noted that financial statements based on IFRS provide important information on market risk, which is important for these entities (Adamik-Citak, 2011).

The concentration of shares in the industry usually means a very intense competitive struggle between economic entities (Bennenbroek and Harris, 1995). Often, 4-5 of the largest enterprises in the industry control a large part of the market. It means large barriers to entry and exit from the market (Kotha and Nair, 1995). Competition between individual entities is not limited only to operational activities, but also financial ones, including competition for external sources of financing, in particular for share capital. The use of IFRS is a way to gaining equity capital and authenticating your business and financial reporting. Acquiring share capital at a lower cost may facilitate competitive struggle, especially in industries with large capital expenditures.

For purposes of empirical analysis the following hypotheses have been developed:

- H₁ – ROE is higher in companies using IFRS
- H₂ – level of risk is lower for economic entities using IFRS
- H₃ – liquidity ratio is higher in companies that adopted IFRS
- H₄ – assets turnover is lower for corporations using IFRS
- H₅ – investment intensity is lower in companies that implemented IFRS
- H₆ – total debt ratio is higher in companies using IFRS
- H₇ – bigger companies implement IFRS
- H₈ – company growth is higher in companies using IFRS
- H₉ – older companies use IFRS
- H₁₀ – international activity is greater in economic entities that introduced IFRS
- H₁₂ – industry concentration is higher in companies using IFRS

The definitions of particular variables included in the analysis are listed below:

- IFRS (1;0); when a company applies IFRS, the variable takes "1", if it applies local standards (local GAAP) then the variable takes "0",
- ROE = 100%*net result/equity capital,

- liquidity = current liabilities/current assets,
- capital intensity = fixed assets/total assets,
- asset turnover = operating activity revenue/value of assets,
- total debt ratio = value of short and long-term liabilities/ total liabilities,
- risk = EBIT standard deviation for the last 4 years,
- company size = \ln (revenue from operating activity)³,
- company age = the number of years in business,
- growth potential = annual increase of revenue from operating activity in %,
- international activity = the number of branches abroad,
- concentration of shares in the industry = the value of revenue from operating activity of the four largest branches in the industry/ total revenue of operating activity of all entities in the industry,
- market share = revenue from operating activity of a specified entity/total revenue from operating activity of all entities in the industry.

3 Results and Discussion

The analysis included 461 listed companies from Germany, Great Britain, Finland, Italy and France, and the empirical data were collected for 2012- 2016. In the test sample, p of Shapiro-Wilk test was below 0.05, hence the analysis was conducted with the application of Mann-Whitney test (Table 1 and 2). P values below 0.05 indicate those variables which are significantly related with the accounting practice.

Table 1 The Dependencies Between IFRS Application by Economic Entities and Financial Measures

Variable	Accounting practice	Average	SD	Median	Q1	Q3	p
ROE	Local GAAP	-6.73	62.37	5.39	-2.75	13.16	p=0.222
	IFRS	-3.21	63.27	6.55	-5.86	14.8	
Risk	Local GAAP	39529	239726	1568	487.63	5336	p<0.001
	IFRS	7186	313698	4976	1584.29	19032	
Liquidity ratio	Local GAAP	0.87	4.88	0.49	0.27	0.75	p<0.001
	IFRS	0.77	1.96	0.59	0.38	0.81	
Assets turnover	Local GAAP	1.19	0.88	1.10	0.80	1.47	p<0.001
	IFRS	1.02	0.63	0.93	0.64	1.23	
Investment	Local GAAP	0.40	0.22	0.39	0.23	0.54	p<0.001
	IFRS	0.47	0.19	0.47	0.33	0.61	
Total debt ratio	Local GAAP	0.78	3.25	0.53	0.37	0.66	p=0.656
	IFRS	0.59	2.41	0.52	0.37	0.67	

Source: Author's own elaboration

In the analysis of IFRS application and the selected financial measures, it should be noted that liquidity ratio values are significantly higher for those companies which apply local accounting standards. Hence, the assumption is confirmed that companies with lesser liquidity and higher risk will seek to reduce it through the use of IFRS. It was noted that capital intensity was significantly higher among those companies which applied IFRS, hence the increased demand for long term capital requires the application of IFRS. The dependency of IFRS on profitability and indebtedness turned out to be insignificant. In addition, it was noted that companies encumbered with higher risk are more likely to apply IFRS (IFRS reduce information cost for the investors). In turn, asset turnover ratio is

³ Company size can be also defined as, value of assets or number of employees.

significantly higher for those companies which apply local accounting standards. High operating efficiency lowers the risk of a company and the cost of its capital.

Table 2 presents the dependencies between the selected non-financial factors and IFRS application. In terms of statistics, the age of companies applying IFRS is significantly higher. This might be attributable to the fact that older companies have the resources allowing application of IFRS. In turn, companies applying IFRS are substantially bigger which possibly stems from the fact that such companies require more capital from the external sources and need to remain accountable to the social and economic environment. Companies applying IFRS have greater share in the market. Such entities, as business leaders, are obliged to sustain the image of their company and the quality of financial reporting. For this reason, they are more likely to apply IFRS. International operations are conducted to a wider extent in entities applying IFRS, which are, for understandable reasons, more accepted or even required for entities operating internationally (globally). The relationship between IFRS and the concentration of market shares and growth opportunities proved to be statistically insignificant.

Table 2 The Dependencies Between IFRS Application by Economic Entities and Selected Non-financial Measures

Variable	Accounting practice	Average	SD	Median	Q1	Q3	p
Company size	Local GAAP	10.70	2.40	10.54	9.24	12.01	p<0.001
	IFRS	11.74	2.38	11.59	10.30	13.02	
Company growth	Local GAAP	14.35	73.92	5.24	-8.44	18.44	p=0.341
	IFRS	18.52	349.53	4.96	-8.34	16.37	
Company age	Local GAAP	45.85	70.79	23.00	11.00	54.00	p<0.001
	IFRS	44.25	41.68	30.00	14.00	58.00	
International activity	Local GAAP	1.70	1.47	1.39	0.69	2.56	p<0.001
	IFRS	2.69	1.51	2.56	1.61	3.66	
Market share	Local GAAP	3.66	10.76	0.19	0.04	2.18	p<0.001
	IFRS	6.29	12.97	0.92	0.16	4.69	
Industry concentration	Local GAAP	84.05	11.01	86.6	78.11	92.73	p=0.478
	IFRS	84.19	9.92	84.8	78.22	91.38	

Source: Author's own elaboration

4 Conclusions

IFRS should be considered the most mature attempt to harmonize local accounting standards. The introduction of IFRS has undoubtedly become the biggest revolution in accounting history in over 120 countries. They affect many spheres of activity, such as, among others, the cost of capital, risk, profitability, liquidity, the quality of financial reporting, the phenomenon of profit management, etc. This paper focused on the dependencies between IFRS application and the selected financial and non-financial measures of economic entities' performance such as profitability, liquidity ratio, assets turnover, investment intensity, total debt ratio, company size, company growth, company age, international activity, market share and industry concentration.

This paper has shown that the production sector of listed companies, operating in the selected countries of Western Europe and applying IFRS, demonstrate higher risk, lower liquidity, lower assets turnover, higher capital intensity, and they are relatively older and larger entities more actively engaged in the international activity. In addition, they control larger market share than those entities which do not apply IFRS. Therefore, the relationship between IFRS and liquidity assets turnover, company ages, company, international activity and market share should be verified positively. Thus, dependencies with non-financial

variables are more predictable than with financial variables. The dependencies between IFRS and risk and investment capacity have been verified negatively. A higher level of risk was observed in companies using IFRS. Thus, in the surveyed company population, reducing the total risk of a company by preparing the high quality of the financial statements is not significant. Public manufacturing companies listed on the stock exchange are not characterized by a large level of risk, hence the introduction of IFRS does not significantly reduce the risk. In companies using IFRS, the capital intensity is higher. An important factor for these companies may be valuation of fixed assets according to fair value recommended by IFRS.

References

- Adamik-Citak, M. (2011). Porównanie informacji zawartej w sprawozdaniu finansowym prezentowanym według IFRS ze sprawozdaniem finansowym sporządzonym zgodnie z polskim prawem bilansowym. *Zeszyty Teoretyczne Rachunkowości*, vol. 60(116), pp. 19–30.
- André, P., Walton, P., Yang, D. (2012). Voluntary Adoption of IFRS: A Study of Determinants for UK Unlisted Firms. In: *Comptabilités et Innovation (pp. cd-rom)*, pp. 1–39.
- Ball, R. (2006). International Financial Reporting Standards (IFRS): pros and cons for investors. *Accounting and business research*, vol. 36 (sup1), pp. 5–27.
- Bessieux-Ollier, C., Walliser, E. (2012). Why Firms Listed on an Unregulated Financial Market Comply Voluntarily with IFRS: An Empirical Analysis with French Data. In: *Comptabilités et Innovation*, pp. 1–36.
- Bennenbroek, N., Harris, R. I. D. (1995). An investigation of the determinants of profitability in New Zealand manufacturing industries in 1986–87. *Applied Economics*, vol. 27(11), pp. 1093–1101.
- Bova, F., Pereira, R. (2012). The Determinants and Consequences of Heterogeneous IFRS Compliance Levels Following Mandatory IFRS Adoption: Evidence from a Developing Country. *Journal of International Accounting Research*, vol. 11(1), pp. 83–111.
- Chi, J., Padgett, C. (2006). Operating performance and its relationship to market performance of Chinese initial public offerings. *Chinese Economy*, vol.39(5), pp. 28–50.
- Cuijpers, R., Buijink, W. (2005). Voluntary Adoption of Non-local GAAP in the European Union: A Study of Determinants and Consequences. *European Accounting Review*, vol. 14(3), pp. 487–524.
- Daske, H. (2006). Economic Benefits of Adopting IFRS or US-GAAP–Have the Expected Cost of Equity Capital Really Decreased?. *Journal of Business Finance & Accounting*, vol. 33(3–4), pp. 329–373.
- Daske, H., Hail, L., Leuz, C., Verdi, R. (2008). Mandatory IFRS Reporting Around the World: Early Evidence on the Economic Consequences. *Journal of Accounting Research*, vol. 46(5), pp. 1085–1142.
- Dumontier, P., Raffournier, B. (1998). Why Firms Comply Voluntarily With IAS: An Empirical Analysis with Swiss Data. *Journal of International Financial Management & Accounting*, vol. 9(3), pp. 216–245.
- Fijałkowska, J., Jaruga-Baranowska, M. (2007). The Impact of IAS/IFRS Adoption on the Presentation of the Financial Position and Performance of Polish Listed Companies. *Theoretical Journal of Accounting*, vol. 41, pp. 97–114.
- Fitó, A., Gómez, F., Moya, S. (2012). Choices in IFRS Adoption in Spain: Determinants and Consequences. *Accounting in Europe*, vol. 9(1), pp. 61–83.
- Francis, J. R., Khurana, I. K., Martin, X., Pereira, R. (2008). The Role of Firm-Specific Incentives and Country Factors in Explaining Voluntary IAS Adoptions: Evidence from Private Firms. *European Accounting Review*, vol. 17(2), pp. 331–360.

- Gassen, J. Sellhorn, T. (2006). Applying IFRS in Germany – Determinants and Consequences. *Betriebswirtschaftliche Forschung und Praxis*, vol. 58(4), pp. 1-38.
- Goddard, J., Tavakoli, M., Wilson, J. O. S. (2005). Determinants of profitability in European manufacturing and services: evidence from a dynamic panel model. *Applied Financial Economics*, vol. 15(18), pp. 1269-1282.
- Grabiński, K., Kędzior, M., Krasodomska, J. (2013). *Globalne uwarunkowania rachunkowości: systemy, procesy, zmiany*, Warszawa: Polskie Wydawnictwo Ekonomiczne.
- Grabiński, K., Kędzior, M. (2007). Wpływ zastosowania Międzynarodowych Standardów Rachunkowości na wartość analityczną sprawozdań finansowych spółek notowanych na Giełdzie Papierów Wartościowych w Warszawie, In: Gabrusewicz W., ed., *Rachunkowość w teorii i praktyce*. Poznań: Wydawnictwo Akademii Ekonomicznej w Poznaniu.
- Gupta, P., Akhter, J., Chaklader, B. (2017). The Impact of IFRS Adoption on Key Financial Ratios-An Analysis of Wipro. *Imperial Journal of Interdisciplinary Research*, vol. 3(4).
- Hope, O. K., Jin, J., Kang, T. (2006). Empirical Evidence on Jurisdictions that Adopt IFRS. *Journal of International Accounting Research*, 2006, vol. 5(2), pp. 1-20.
- Kędzior, M. (2012). Capital Structure in EU Selected Countries – Micro and Macro Determinants. *Argumenta Oeconomica*, vol. 28(1), pp. 69-117.
- Kędzior, M. (2015). Dobrowolne stosowanie IFRS przez spółki giełdowe w wybranych krajach Europy Zachodniej. *Zeszyty Teoretyczne Rachunkowości*, vol. 81(137), pp. 123-136.
- Kim, J.-B., Liu, X., Zheng, L. (2012). The impact of mandatory IFRS adoption on audit fees: theory and evidence. *The Accounting Review*, no. 87, pp. 2061-2094.
- Li, S. (2010). Does Mandatory Adoption of International Financial Reporting Standards in the European Union Reduce the Cost of Equity Capital?. *The Accounting Review*, vol. 85(2), pp. 607-636.
- Maślanka, T. (2012). Wartości krytyczne wybranych wskaźników analizy finansowej – wnioski z badań nad upadłością przedsiębiorstw notowanych na GPW w Warszawie w latach 2000–2011. In: Owsiak, S., ed., *Stabilność systemu finansowego warunkiem rozwoju gospodarczego*. WSFiP w Bielsku-Białej, pp. 206-219.
- Maślanka, T., Mazur-Maślanka I. (2017). Wybrane wskaźniki finansowe w okresie przed upadłością w przedsiębiorstwach budowlanych. *Kwartalnik Nauk o Przedsiębiorstwie*, vol. 1(42), pp. 73-84.
- Okwo, I. M., Enekwe, C. I., Okelue, U. D. (2012). Financial Management as a Determinant of Profitability: a Study of Selected Pharmaceutical Firms in Nigeria. *European Journal of Business and Management*, vol. 4(20), pp. 28-36.
- Renders, A., Gaeremynck, A. (2007). The Impact of Legal and Voluntary Investor Protection on the Early Adoption of International Financial Reporting Standards (IFRS). *De Economist*, vol. 155(1), pp. 49-72.
- Persakis, A., Iatridis, G. E. (2017). The joint effect of investor protection, IFRS and earnings quality on cost of capital: An international study. *Journal of International Financial Markets, Institutions and Money*, vol. 46, pp. 1-29.
- Pichler, S., Cordazzo, M., Rossi, P. (2018). An analysis of the firms-specific determinants influencing the voluntary IFRS adoption: evidence from Italian private firms. *International Journal of Accounting, Auditing and Performance Evaluation*, vol. 14(1), pp. 85-104.
- Şenyiğit, Y. B. (2014). Determinants of Voluntary IFRS Adoption in an Emerging Market: Evidence from Turkey. *Accounting and Management Information Systems*, vol. 13, pp. 449-465.

Comparison of Gulka's Model and Model IN05 on Sample of Slovak Industrial Companies

Natália Klempaiová¹, Mária Bohdalová²

¹ Comenius University in Bratislava
Faculty of Management, Department of Information Systems
Odbojárov 10, Bratislava, 820 05, Slovakia
E-mail: natalia.klempaiova@fm.uniba.sk

² Comenius University in Bratislava
Faculty of Management, Department of Information Systems
Odbojárov 10, Bratislava, 820 05, Slovakia
E-mail: maria.bohdalova@fm.uniba.sk

Abstract: *In this paper, we analyse two modern bankruptcy models on samples of selected Slovak industrial enterprises. IN05 is a well-known model in Slovakia that gives a high percentage of reliability in predicting the financial health of Slovak companies. The Gulka's model was created in 2016 and its popularity is rising. The aim of this paper is to compare IN05 and Gulka's models and determine which of them is more suitable for Slovak enterprises. Analyses were based on real data from the latest available financial statements of industrial enterprises for five industries typical of Slovakia: Automotive, Electricity, Agriculture and Forestry, Construction, Mechanical Engineering. We have selected private domestic companies with limited liability. In the case of companies in bankruptcy or restructuring, we used the latest available financial statements before the date of bankruptcy or, respectively, management of restructuring. Using contingency tables, we compared the number of correct predictions for both models - the Gulka's model, created by the logistic regression method (LOGIT model) and the IN05 index created by the Multidimensional Discrimination Analysis (MDA method). We predicted the correct forecast when the company was actually in bankruptcy and the model rated it or if the company was not bankrupt and the model ranked it as prosperous. Both models are very useful in the conditions of the Slovak Republic. For Slovak industrial enterprises, the Gulka's model is more reliable. In general, the model's highest ability to leverage is in the country where the model was created or for the industry for which it was created.*

Keywords: *Index IN05, Gulka's model, corporate financial health forecast, credit and bankruptcy models*

JEL codes: *C35, M10, G32*

1 Introduction

Predictive ability of any bankruptcy model depends on time, location, industry for which it was developed, and also on the used method. Our research focuses on modern bankruptcy models that can estimate the financial situation of Slovak companies as accurately is possible. In this paper, we focused on Slovak or Czech models because the economic situation is similar in both countries (Diheneščíková and Hičák, 2011).

There are several Slovak bankruptcy models. For example, Chrastinová's CH-index (Chrastinová, 1998) or Gurčík's model (Gurčík, 2002) are aimed for agriculture. Binkert (Binkert, 1999) developed bankruptcy model for joint stock companies, Hurtošová (Hurtošová, 2008) created model for personal and legal entities accounting for double-entry accounting and Gulka's model (Gulka, 2016) was developed for Slovak trading companies. Only Gulka's model could easily differentiate prosperous and unprosperous businesses. In the study by (Đurica and Zvaríková, 2017), models created for V4 countries were compared, either through Multidimensional Discrimination Analysis (MDA) or logistic regression (LOGIT models).

Based on the above, we decided to look more closely at the perspective for future Gulka's model and to compare it with the frequently used the Czech index IN05 (Neumaierová and Neumaier, 2005), which also proved to be successful in Slovakia (Bohdalová and Klempaiová, 2017). Our aim is to compare and analyse the predictive power of the IN05 model and Gulka's model on samples of selected Slovak industrial enterprises and to determine which of them is more suitable for Slovak companies.

The Gulka's model was obtained using a logistic regression method. The math entry is as follows (Gulka, 2016):

$$p = \frac{e^{0,0216-0,6131 \cdot X1-0,0068 \cdot X2-0,0293 \cdot X3-0,0011 \cdot X4+0,0240 \cdot X5+0,0317 \cdot X6-1,0663 \cdot X7}}{1 + e^{0,0216-0,6131 \cdot X1-0,0068 \cdot X2-0,0293 \cdot X3-0,0011 \cdot X4+0,0240 \cdot X5+0,0317 \cdot X6-1,0663 \cdot X7}} \quad (1)$$

where

$X1$ – Quick Ratio – (Financial accounts / (Short-term liabilities + Short-term financial borrowings + Current bank loans))

$X2$ – Working Capital Turnover = ((Revenue from sold goods + Manufacture) / Working capital; while WC is Current assets – Short-term liabilities – Short-term financial borrowings – Current bank loans)

$X3$ – Financial Accounts Ratio (in %) – (Financial accounts / Total Assets)

$X4$ – Self-financing Ratio (in %) – (Equity / Total Assets)

$X5$ – Credit load (in %) – ((Fixed Bank loans + Short-term financial accommodations) / Total Assets)

$X6$ – Share of liabilities to state institutions (in %) – ((Payables from social insurance + Tax liabilities and grants) / Total Assets)

$X7$ – Return on Assets from the perspective of EBITDA – (EBITDA / Total Assets; while EBITDA = Profit from economic activity + Depreciation + Residual cost of the sold long-term assets and material – Revenue from the sale of long-term assets and material)

p – probability the company will go bankrupt during the next 12 months

if $1 \geq p \geq 0,50$, an enterprise is heading to bankruptcy

and if $0,50 > p \geq 0$, the enterprise is not heading to bankruptcy

Index IN05 was created by modifying Altman's methodology for the conditions of Czech businesses using a multidimensional discriminatory analysis:

$$IN05 = 0,13 \cdot \frac{A}{CZ} + 0,04 \cdot \frac{EBIT}{\dot{U}} + 3,97 \cdot \frac{EBIT}{A} + 0,21 \cdot \frac{V\dot{Y}N}{A} + 0,09 \cdot \frac{OA}{KZ + KB\dot{U}} \quad (2)$$

where

A – Assets respectively Liabilities

CZ – Foreign Sources

$EBIT$ – Earnings before Interest and Taxes – (Profit before tax + Interest expense)

\dot{U} – Interest Expense

$V\dot{Y}N$ – Total Returns

OA – Current Assets

KZ – Short-term Liabilities

$KB\dot{U}$ – Short-term Bank Loans and Borrowings

If $IN05 > 1.6$, an enterprise creates worthiness with probability 67%.

The area enclosed by $0.9 \leq IN05 \leq 1.6$ is an area of unmatched results (grey zone).

If $IN05 < 0.9$, an enterprise is at risk of bankruptcy with probability 86%.

If interest rates in the EBIT / Ú indicator approach zero, a problem arises. The Neumaier recommend limiting the value of this indicator to 9 (Neumaierová and Neumaier, 2005).

2 Methodology and Data

To analyze Gulka's model and IN05 index, we have selected five sectors that make up a significant part of GDP in Slovakia and are typical for Slovakia. These are privately owned domestic limited liability companies in the automotive, electrical, agricultural and forestry sectors, construction and machinery.

We have drawn the data from the databases of Finstat, L.t.d.(2018). After filtering the five sectors according to Finstat's classification, legal form and type of ownership, a database with 31 431 enterprises was created. Of these, 380 companies were bankrupt with a known bankruptcy date or authorization for restructuring.

We removed empty rows in the indicators needed to calculate p in Gulka's model. We also removed rows with businesses missing the IN05 value, as the database contained already calculated index values of IN05 and its indication. The database was also cleared from companies where assets were not attributable to liabilities and/or were found to be negative in assets, stocks, financial accounts, bank loans, sales, etc. Unlike Gulka, however, we ignored extreme variability in the values of financial indicators. After these adjustments, the number of businesses decreased to 661, of which 15 were in real failure.

We manually searched and added data from the last published financial statements before the date declared as bankruptcy or restructuring authorization for businesses in bankruptcy. We mostly used data from one to two calendar years before the date with public known bankruptcy. Subsequently, companies with missing indicator values required to calculate the value p in Gulka's model or with some of the above accounting anomalies were removed again. Final database sample consisted of 649 businesses, out of which 10 were in real decline.

Subsequently, calculations and the new cut-off thresholds for the IN05 index include only two areas in Gulka's model, in contrast to IN05 model, to determine the prosperity of the business. We calculated the average from the upper (1.6) and the lower (0.9) limits for IN05 model (1.25) to compute new cut-off thresholds similarly as Gulka used for the Altman model (Gulka, 2016). For modified IN05 model, there was a cut-off threshold equal to 1.25. If the calculated value was higher than 1.25, the company was prosperous, and businesses with a value of less than or equal to 1.25 were non-prosperous. For Gulka's model, there was a cut-off threshold of 0.50.

We have calculated individual ratios ($X_1 - X_7$) for all companies according to equation (1) and then we have calculated the probability p . There were situations when the denominator was zero when we calculated the probability p . Therefore, we had to discard four more companies from the database for which it was impossible to calculate their p values. The final database contained 645 businesses, 10 of them were actually bankrupt. After checking duplicity of data, we could proceed with the analysis of both models.

This database was used to find out how many businesses the model labelled as "prosperous" in a group of truly prosperous businesses or non-prosperous in a group of companies in real decline. Models can be compared based on the number of correct answers individually in each group. Given an uneven number of prosperous and unsustainable businesses in the database, we will not be able to determine whether the model is more successful in predicting bankruptcy or predicting business prosperity (whether the model has a tendency to include an enterprise rather to prosperous or non-prosperous companies).

If we would like to determine the success or failure of the models based on a simple sum of the total correctly evaluated companies or the total error rate (census of type I and type

II errors), we would have to use a sample with the same number of prosperous and non-prosperous businesses. Otherwise, we could get a distorted conclusion. If the first model was compared to the other model, it would have a higher tendency to classify businesses as thriving, it would show a higher success rate than the second model in an uneven database with more realistically prosperous businesses. In reality, however, the second model could be more successful. Based on this fact, we used a database in which the number of businesses in real decline (10) and the number of real prosperous businesses (10) was the same. For each bankruptcy or restructuring of companies, we assigned a truly prosperous company with the same SK-NACE business class rating and approximately the same size category, with the main criteria being the number of employees, after which other size criteria were compared.

The analysis was performed using MS Office Excel software.

3 Results and Discussion

We began analysis with the case when businesses were real prosperous (their count was 635) or bankrupt (their count was 10). Table 1 shows the number of prosperous businesses and businesses in bankruptcy or restructuring in total and in individual sectors. There are no companies in the automotive and mechanical engineering sector among companies in decline.

Table 1 Initial State

Bankruptcy and Restructuring	Number of enterprises	% of Total	% of Superior row
Yes	10	1.55	1.55
Electricity	1	0.16	10.00
Agriculture and Forestry	3	0.47	30.00
Construction	6	0.93	60.00
No	635	98.45	98.45
Automotive	3	0.47	0.47
Electricity	19	2.95	2.99
Agriculture and Forestry	172	26.67	27.09
Construction	407	63.10	64.09
Mechanical Engineering	34	5.27	5.35
Total	645	100.00	100.00

Source: Own results processed based on data from www.finstat.sk

We found out which model predicted more business prosperity in a group of truly prosperous businesses and bankruptcy in a group of truly non-prosperous businesses. The results for IN05 model with the modified cut-off boundary and Gulka's model are summarized in Table 2.

In the group of truly prosperous businesses (635), IN05 model with a modified cut-off threshold identified 397 (62.52% of 635) companies in bankruptcy or restructuring and 238 (37.48% of 635) companies as prosperous. Gulka's model identified 322 companies as non-prosperous and 313 as prosperous in this group. In this comparison, it had 75 correct predictions more than IN05 model. In the group of companies that were bankrupt (10), both models agreed. They predicted bankruptcy to 9 businesses and 1 was identified as prosperous, and it was for the same company.

Table 2 Comparison of Prediction - IN05 Model with Cut-off Line 1.25 and Gulka´s Model

Bankruptcy and Restructuring	IN05 model with modified cut-off line (1.25)			Gulka´s model (cut-off line 0.50)		
	Number of enterprises	% of Total	% of Superior row	Number of enterprises	% of Total	% of Superior row
Yes	10	1.55	1.55	10	1.55	1.55
Bankruptcy	9	1.40	90.00	9	1.40	90.00
Prosperity	1	0.16	10.00	1	0.16	10.00
No	635	98.45	98.45	635	98.45	98.45
Bankruptcy	397	61.55	62.52	322	49.92	50.71
Prosperity	238	36.90	37.48	313	48.53	49.29
Total	645	100.00	100.00	645	100.00	100.00

Source: Own results processed based on data from www.finstat.sk

From the 397 enterprises that IN05 model with a modified cut-off threshold identified as bankrupted in a group of real prosperous companies, Gulka´s model marked 254 as non-prosperous and 143 as prosperous. From the 238 enterprises that the revised IN05 model estimated as prosperous companies, both models agreed on 170 businesses. The others (68) were classified by Gulka´s model to be non-prosperous companies (Table 3).

Table 3 IN05 Model with Modified Cut-off line versus Gulka´s Model

Bankruptcy and Restructuring	Number of enterprises	% of Total	% of Superior row
Yes	10	1.55	1.55
Bankruptcy	9	1.40	90.00
Bankruptcy	9	1.40	100.00
Prosperity	1	0.16	10.00
Prosperity	1	0.16	100.00
No	635	98.45	98.45
Bankruptcy	397	61.55	62.52
Bankruptcy	254	39.38	63.98
Prosperity	143	22.17	36.02
Prosperity	238	36.90	37.48
Bankruptcy	68	10.54	28.57
Prosperity	170	26.36	71.43
Total	645	100.00	100.00

Source: Own results processed based on data from www.finstat.sk

It means that from the 322 companies that Gulka´s model estimated as a non-prosperous in a group of truly prosperous companies, IN05 model with a changed cut-off threshold marked 68 companies as prosperous and 254 as non-prosperous. From the 313 enterprises that Gulka´s model identified as prosperous, 143 as non-prosperous and 170 prosperous companies were determined by modified model IN05 (Table 4).

We also looked at whether the business was indeed prosperous or non-prosperous if the model marked it so. The analysis has been done on a sample of 20 companies filtered from the original database with 645 companies. 10 companies were bankrupt and 10 were not bankrupt. The sample consisted mostly of the construction industry. It did not include Automotive and Mechanical Engineering industries because there are no bankrupt companies in the original database with 645 enterprises.

Table 4 Gulka´s Model versus IN05 Model with Modified Cut-off Line

Bankruptcy and Restructuring	Number of enterprises	% of Total	% of Superior row
Yes	10	1.55%	1.55%
Bankruptcy	9	1.40%	90.00%
Bankruptcy	9	1.40%	100.00%
Prosperity	1	0.16%	10.00%
Prosperity	1	0.16%	100.00%
No	635	98.45%	98.45%
Bankruptcy	322	49.92%	50.71%
Bankruptcy	254	39.38%	78.88%
Prosperity	68	10.54%	21.12%
Prosperity	313	48.53%	49.29%
Bankruptcy	143	22.17%	45.69%
Prosperity	170	26.36%	54.31%
Total	645	100.00%	100.00%

Source: Own results processed based on data from www.finstat.sk

IN05 model with an amended cut-off marked 16 out of 20 enterprises to be bankrupt, of which there were 9 companies in bankruptcy or restructuring and 7 were not. 4 businesses were declared prosperous, of which 1 was actually bankrupt and 3 were actually prosperous. As can be seen in Table 5, the same is valid for Gulka´s model.

Table 5 Comparison of Prediction for 20 Companies

	IN05 model with modified cut-off line (1.25)			Gulka´s model (cut-off line 0.50)		
	Number of enterprises	% of Total	% of Superior row	Number of enterprises	% of Total	% of Superior row
Bankruptcy	16	80.00	80.00	16	80.00	80.00
Yes	9	45.00	56.25	9	45.00	56.25
No	7	35.00	43.75	7	35.00	43.75
Prosperity	4	20.00	20.00	4	20.00	20.00
Yes	1	5.00	25.00	1	5.00	25.00
No	3	15.00	75.00	3	15.00	75.00
Total	20	100.00	100.00	20	100.00	100.00

Source: Own results processed based on data from www.finstat.sk

However, the predictions of the two models differ slightly. From the 16 companies that were predicted by IN05 model with the modified cut-off threshold as bankrupt, there were only 15 marked as non-prosperous by Gulka´s model. 1 business was identified as prosperous, and it also corresponded to the reality. Modified IN05 model classified this business as non-prosperous. From the 4 companies that IN05 model with the changed cut-off boundary classified as prosperous, 1 was classified as non-prosperous by Gulka´s model. However, this business was prosperous. From 3 other companies classified by Gulka´s model to be prosperous, 2 were prosperous and 1 bankrupt. The company that was bankrupt and was among those four companies was evaluated as prosperous by both models (Table 6).

Based on the results of the analyses, we can evaluate Gulka´s model as slightly more successful in comparison to IN05 model with the changed cut-off-border. In the group of

truly prosperous businesses, more businesses were rated as prosperous, in the group of companies in real decline, the situation was balanced in both models. When investigating whether the business was actually bankrupt or prospering, both Gulka's model and IN05 model with cut-off boundary resulted in 7 false negatives (error of type II). Both models resulted in 1 false positive (error of type I). In this investigation, the status of both models was balanced.

Table 6 IN05 Model with Modified Cut-off Line versus Gulka's Model – 20 Companies

	Number of enterprises	% of Total	% of Superior row
Bankruptcy IN05	16	80.00	80.00
Bankruptcy Gulka	15	75.00	93.75
Yes	9	45.00	60.00
No	6	30.00	40.00
Prosperity Gulka	1	5.00	6.25
No	1	5.00	100.00
Prosperity IN05	4	20.00	20.00
Bankruptcy Gulka	1	5.00	25.00
No	1	5.00	100.00
Prosperity Gulka	3	15.00	75.00
Yes	1	5.00	33.33
No	2	10.00	66.67
Total	20	100.00	100.00

Source: Own results processed based on data from www.finstat.sk

4 Conclusions

In our analysis, Gulka's model came out slightly more successful than the IN05 model, but it is questionable to declare it as more successful than the IN05 model. In practice, nobody uses IN05 model with a modified cut-off boundary because it was only used to make the comparison of both models feasible. The advantage of Gulka's model is that it was created by a method of logistic regression (generally considered to be more accurate than methods of multidimensional discriminatory analysis), it is newer than IN05 index and it is created based on Slovak businesses data (IN05 index is a Czech model) including industrial companies (IN05 index was based on Czech industrial enterprises). These factors could cause that Gulka's model is more successful than IN05 index in the conditions of the Slovak Republic and therefore more suitable for Slovak companies.

References

- Binkert, C. H. (1999). *Fruherkennung von Unternehmenskrisen mit Hilfe geeigneter Methoden im deutschen Unauthenticated*. Dissertation thesis.
- Bohdalová, M., Klempaiová, N. (2017). Comparison of bankruptcy models for prediction of the financial health of the Slovak civil engineering companies. In: *Proceedings of the 16th International Conference Perspectives of Business and Entrepreneurship Development in Digital Age*. Brno: University of Technology, pp. 41-49.
- Chrastinová, Z. (1998). Metódy hodnotenia ekonomickej bonity a predikcie finančnej situácie poľnohospodárskych podnikov. Bratislava: VÚEPP, p. 34.
- Diheneščíková, D., Hičák, Š. (2011). Index IN05 v priemyselných podnikoch na východnom Slovensku. *Trendy v podnikaní*, vol. 1(2), pp. 39-43.
- Đurica, M., Zvaríková, K. (2017). MDA vs. Logit bankruptcy models in the Slovak Republic. In: *Proceedings of the 11th International Scientific Conference Financial Management of*

Firms and Financial Institutions. Ostrava: VŠB – Technická univerzita Ostrava, pp. 214-221.

Finstat, L.t.d (2018). *Dataset finančných výkazov*. Retrieved from: <https://finstat.sk/datasety-na-stiahnutie>.

Gulka, M. (2016). Model predikcie úpadku obchodných spoločností podnikajúcich v podmienkach SR. *Biatic*, vol. 24(6), pp. 5-9.

Gurčík, L. (2002). G-index-metóda predikcie finančného stavu poľnohospodárskych podnikov. *Agricultural Economics*, vol. 48(8), pp. 373-378. Retrieved from: <http://www.cazv.cz/2003/anglicka/clanky/ekon8-02/gurcik.pdf>. ISSN 0139-570X.

Hurtošová, J. (2008). Postup vývoja ratingového modelu. *Trendy ekonomiky a managementu*, vol. 22, pp.34-40. ISSN 1802-8527.

Neumaierová, I., Neumaier, I. (2005). Index IN05. In: *Sborník příspěvků z mezinárodní vědecké konference Evropské finanční systémy 2005*. Brno: Masarykova univerzita, pp. 143-148.

Valášková, K., Švábová, L., Ďurica, M. (2017). Verifikácia predikčných modelov v podmienkach slovenského poľnohospodárskeho sektora. *Ekonomika Management Inovace*, vol. 9(3), pp. 30-38.

The Efficiency of Health Systems in OECD Countries with Novel DEA Methodology

Kristína Kočíšová¹, Jakub Sopko²

¹ Technical University
Faculty of Economics, Department of Banking and Investments
Němcovej 32, 040 01 Košice, Slovak Republic
E-mail: kristina.kocisova@tuke.sk

² Technical University
Faculty of Economics, Department of Banking and Investments
Němcovej 32, 040 01 Košice, Slovak Republic
E-mail: jakub.sopko@tuke.sk

Abstract: *The main purpose of this paper is to determine the relative scores of the efficiency of health systems in the OECD countries. The data used in the analysis of this paper has been obtained from the official OECD database and we have been analyzing the data between 2005 and 2015. We use the health indicators to point out the performance of healthcare systems of individual OECD countries. The efficiency results are obtained by Data Envelopment Analysis (DEA). DEA is an analysis of the efficiency of production units, which give us the efficiency score of the specified individual units. DEA is also used for the examination of the efficiency in the services sector. In this way, we can point to the level of efficiency of the health systems of the individual OECD countries. Traditional DEA methods are limited in some cases with regard to the nature of the selected variables. Emrouznejad and Amin (2009) point to the limitations of DEA models using the indicators expressed as ratio variables. In our paper, we will use the novel method for assessing efficiency – Dynamic Network Data Envelopment Analysis (DNDEA), applied by Ozcan and Khushalani (2016).*

Keywords: *public health, Data Envelopment Analysis, DNDEA, OECD, efficiency*

JEL codes *I15, H51, C61*

1 Introduction

The process of shaping individual sectors of the national economy can be monitored on the basis of the characteristic changes that have been deepening in the given period. The national economy represents the basic cycle of economic processes, which includes four basic economic sectors: the primary, secondary, tertiary and quaternary. A major change in the development of the national economy has led to deindustrialization – the shift of labor force from the industrial sector. The beginning of this process has gradually become the fastest growing and currently one of the most important sectors of the national economy, the service sector. Important fields of the tertiary sector include health and education. These areas of service sector can be quantified by a number of methods. The results being known as determinants of health and education. The educational level of the country and the adequate health status of the population affect the development of the regions. In most countries, we still see poor regions and regions with poor healthcare infrastructure. Often these problems are associated with inefficient financing in the country. At the present we are often confronted with the increasing trend of investment and innovation in the service sector. The service sector is known as a faster developing sector compared to other. Health and education are areas in which the country in recent years invested considerable percentage of funds. Therefore, we can further consider the analysis of the efficiency of inputs and outputs of health and education policy. Among the best-known and most widely used methods of measuring efficiency in the service sector are Data Envelopment Analysis models (DEA). In our work we try to estimate the efficiency of health systems based on data obtained from the OECD (*Organisation for Economic Co-operation and Development*) database using the DEA analysis.

The paper is organized as follow: In the section 2 a preview of the relevant literature is provided. In the section 3, the methodology and data are described and the section 4 presents the key findings and results.

2 Literature preview

Several authors address issues of efficiency in the healthcare sector. The OECD and the World Health Organization (WHO) offer several publications and reports (2017, 2018) that tell us about health care situation. The literature overview on efficiency in the health sector is also shown in Table 1.

Tandon et al. (2001) in their work point out that with the increase of health expenditure per capita, overall results of the country have increased. They analyze 191 countries and the relative efficiency score of the health expenditure. Countries with a high incidence of AIDS and HIV had a low level of efficiency. As the worst countries were: Malawi, Botswana, Namibia, Zambia and Zimbabwe, while the best performing countries were: Italy, France, San Marino, Malta, Oman. Sinimole (2012) analyzes the efficiency in 180 WHO countries. The results show that 45 out of 180 countries were efficient. Using the DEA model, it estimates the relative efficiency of WHO countries, pointing to five types of indicator groups: health status, health system, risk, health service coverage, demographic socio-economic situation and statistics and the author uses data, which belong under the groups of health status and health service coverage.

Table 4 DEA Models Specification Used in the Reviewed Studies

Paper Data & Methods	
Inputs & Outputs	Results
Retzlaff-Roberts et. al. (2004) 27 OECD countries; DEA models	
Inputs: Beds, MRI, Physicians, Health expenditure, Tobacco use, Gini coefficient Outputs: Infant mortality, Life expectancy	Australia, UK, Sweden, Turkey, Spain, Norway, Mexico, Australia, Canada, Japan, France, Ireland, Greece, Korea are efficient. Therefore, they have found that the country can be technically efficient or inefficient at any level of health outcomes.
Spinks and Hollingsworth (2009) 28 OECD countries, DEA & Malmquist index, 1995 and 2000	
Inputs: Expected years of schooling under current conditions excluding education for children under five, Unemployment rates as percentage of total workforce, GDP per capita, Health expenditure per capita Outputs: Life expectancy	Efficient countries: In 1995 – Spain, Japan, Korea, Greece, Mexico, Turkey. In 2000 – Spain, Japan, Switzerland, Korea, Iceland, Turkey, Mexico, Greece.
Hadad et al. (2013) 31 OECD countries, DEA models and multivariate linear regression	
Inputs: Physicians density, Inpatient bed density, Health expenditure, GDP, Fruit and vegetable expenditure. Outputs: Life expectancy, Infant mortality; Control variables: Fat intake, Health expenditure, Unemployment, Gini index, Environmental health score, Organizational arrangements, Use of disease management programs, Gatekeeping, Performance related payment incentives	9 countries (Australia, Canada, Israel, Italy, Luxembourg, Spain, Sweden, Switzerland, and the United Kingdom) as efficient.
Jeremic et al. (2012) 27 European countries, Distance based analysis	
Inputs: Nurses, Physicians, Dentists, Public and total health expenditure, Beds Outputs: Life expectancy, Healthy life expectancy; Adults, under 5, infants, mothers mortality rate	Cyprus and Ireland have a most efficient health system. New model for evaluating the efficiency score is presented.
Sinimole (2012) 180 WHO countries, DEA models	
Inputs: Nurses, Physicians, Health expenditure Outputs:	45 out of 180 countries are relatively efficient in providing health services. 12 out of 48 efficient

Adult, infant, neonatal and under 5 mortality rate, immunization coverage	countries are EU countries. Most countries are countries with low input variables (e.g. density of doctors, expenditure on health) but these countries produce high output values.
Tajnikar and Došenović Bonča (2007)	
16 EU countries, DEA models and group comparison	
Physicians, Beds, Discharges, Consultations, Health expenditure	Health care provision is more efficient in countries where the private ownership of providers is predominant and where health care systems follow the social insurance model.
Outputs:	
Life expectancy (male, female), Mortality rate, Discharges, Physicians consultations	
Samut and Cafri (2015)	
29 OECD countries between 2000 - 2010, DEA models, Malmquist Productivity, Panel Tobit Model	
Beds, Physicians, Nurses, MRI, CT	6 countries were fully efficient in 2010. Fully efficient during period 2000-2010 were Mexico, Turkey and the UK. Japan, Iceland, France and Belgium have under average efficiency scores for all the years.
Outputs:	
Discharge rates from all hospitals, Infant survival rate.	
Independent variables: GDP, Health expenditure (public and private), educational expenditure, Public hospital, Private hospital, Life expectancy	
Ozcan and Khushalani (2016)	
34 OECD countries between 2000 and 2012, Dynamic Network DEA	
Alcohol and tobacco consumption, Obese population, Public and private health expenditure, CT, Physicians, Hospital beds	14 out of 34 countries underwent reform between period. Average overall Malmquist score for these countries was 0.98. Austria, Canada, US, Mexico, Turkey and Norway improved efficiency scores of the overall health system over time.
Outputs:	
Life expectancy at birth (male and female), Discharges, Consults. Carry over variables: Mortality (maternal and infant), Health status.	
Medical care division: Immunization, Cancer, Screening-breast and cervical cancer.	
Behr and Theune (2017)	
34 OECD countries, DEA models	
Beds, Physicians, Nurses, Cataract surgery, Coronary artery bypass graft, Transplantation of kidney, Health expenditure, GDP, Gini coefficient, Alcohol and tobacco consumption, Obesity.	Germany was inefficient at producing surgeries. Denmark – the country with the highest sum of weighted inputs. Japan was the most inefficient country in analysis of lifestyle and mortality. Norway, Switzerland, Luxembourg and USA – extremely low efficiency scores in the analysis of life expectancy and health expenditure.
Outputs:	
Infant mortality, 30-day mortality after admission to hospital for ischemic stroke and for acute myocardial infarction per 100 patients; Life expectancy at birth	

Source: prepared by authors

Samut and Cafri (2016) use the Malmquist index and the regression analysis extended by the Tobit model in addition to the DEA analysis. The authors try to estimate the efficiency and the changes in the efficiency of key determinants of health systems on the sample of 29 OECD countries between 2000 and 2010. 6 countries were fully effective in 2010. Fully efficient during the period 2000-2010 were Mexico, Turkey and the UK. Japan, Iceland, France and Belgium have under-average efficiency scores for all years.

3 Methodology and Data

One of the most well-known methods for estimating efficiency in the healthcare sector is Data Envelopment Analysis. Efficiency is in this case in the form of ratio of health output to health input. The goal is to minimize the input side given the certain volume of outputs or to maximize the output given a certain volume of inputs. Data Envelopment Analysis is a non-parametric method that estimates the efficiency of production units. Koopmans (1951), Debreau and Arrow (1954) and Farrell (1957) have provided a basic concept for DEA development with their articles. Debreau and Arrow (1954) and Farrell (1957) have introduced the score of technical efficiency rate. In the next period, DEA was the subject of several authors. The further development of this method was provided by Charnes et al. (1978) who introduced the CCR (Charnes, Cooper, Rhodes) model based on the constant returns to scale and Banker et al. (1984) developed the BCC (Bankers, Charnes, Cooper) model based on the variable returns to the scale (VRS). The Network DEA

represents a new approach to the assessment of the efficiency, which is needed on the one hand to understand the past success of the organization and on the other hand for planning to the future. The network DEA helps identify the specific factors which point to the inefficiency of the decision making units (DMUs) as a whole (Kao, 2017).

Dynamic Network Data Envelopment Analysis (DNDEA) specification

Standard DEA models are often referred as a "black box" models, because they do not take into account the internal factors and structure of DMUs. Tone and Tsutsui (2009) in their analysis present new types of Dynamic Network DEA models, taking into account the internal or linking structure of DMUs. Färe and Grosskopf (1997, 2000) present their network of DEA models with various types of structure. The DNDEA model can evaluate the overall efficiency, dynamic change in the periodic efficiency and dynamic change in the divisional efficiency. In the health sector, the advantage of DNDEA is that it assesses efficiency separately in public health and also medical care provision. DMUs have carry-over variables that take into account a positive or negative factor in the previous period (Ozcan and Khushalani, 2016). Kawaguchi et al. (2014) use DNDEA with estimating the efficiency of Japanese hospitals.

Consider n DMUs ($j=1, \dots, n$), which consist of K divisions ($k=1, \dots, K$) over T time periods ($t=1, \dots, T$). The number of inputs and outputs to division k represent m_k and r_k , respectively. The set of links L_{kh} point from division k to division h by (k, h) and the observed data are as follows (Kawaguchi et al. 2014):

$x_{ijk}^t \in R_+$ ($i=1, K, m_k; j=1, K, n; k=1, K, K; t=1, K, T$) represents input resource I to DMU_j for division k in the period t ;

$y_{rjk}^t \in R_+$ ($r=1, K, r_k; j=1, K, n; k=1, K, K; t=1, K, T$) represents output product r from DMU_j for division k in period t . We treat the outputs, which are undesirable, as inputs to division k .

$z_{j(kh)_t}^t \in R_+$ ($j=1, K, n; l=1, K, L_{kh}; t=1, K, T$) define the linking intermediate products of DMU_j from k to h in period t

$z_{jk_t}^{(t, t+1)} \in R_+$ ($j=1, K, n; l=1, K, L_k; k=1, K, K; t=1, K, T-1$) represents carry-over of DMU_j. DMU_o ($o=1, K, n$) $\in P$ can be expressed as follows:

$$\begin{aligned} \mathbf{x}_{ok}^t &= X_k^t \lambda_k^t + \mathbf{s}_{ko}^{t-} \quad (\forall k, \forall t) \\ \mathbf{y}_{ok}^t &= Y_k^t \lambda_k^t + \mathbf{s}_{ko}^{t+} \quad (\forall k, \forall t) \\ \mathbf{e} \lambda_k^t &= 1 \quad (\forall k, \forall t) \\ \lambda_k^t &\geq 0, \mathbf{s}_{ko}^{t-} \geq 0, \mathbf{s}_{ko}^{t+} \geq 0, \quad (\forall k, \forall t) \end{aligned} \tag{1}$$

where

$X_k^t = (\mathbf{x}_{1k}^t, K, \mathbf{x}_{nk}^t) \in R^{m_k \times n}$ and $Y_k^t = (\mathbf{y}_{1k}^t, K, \mathbf{y}_{nk}^t) \in R^{r_k \times n}$ represent input and output matrices and \mathbf{s}_{ko}^{t-} and \mathbf{s}_{ko}^{t+} represent input and output slacks, respectively.

In the "as input" link value case, the linking activities are treated as input to division and excesses are accounted for in the input inefficiency:

$$\mathbf{z}_{o(kh)in}^t = Z_{(kh)in}^t \lambda_k^t + \mathbf{s}_{o(kh)in}^t \quad ((kh)in=1, K, linkin_k) \tag{2}$$

and in the "as output" link value case, the linking activities are treated as output from the preceding division and shortages are accounted for in the output inefficiency:

$$\mathbf{z}_{o(kh)out}^t = Z_{(kh)out}^t \lambda_k^t - \mathbf{s}_{o(kh)out}^t \quad ((kh)out=1, K, linkout_k) \tag{3}$$

where $s_{o(kh)in}^t \in R^{L_{(kh)in}}$ represents slacks and is non-negative, $linkin_k$ represents the number of “as input” links and $s_{o(kh)out}^t \in R^{L_{(kh)out}}$ represents slacks and is non-negative and $linkout_k$ is the number of “as output” links from k division.

Carry over categories can be expressed as follows:

$$\begin{aligned}
z_{okjgood}^{(t,t+1)} &= \sum_{j=1}^n z_{jkjgood}^{(t,t+1)} \lambda_{jk}^t - s_{okjgood}^{(t,t+1)} \quad (k_l = 1, K, ngood_k; \forall k; \forall t) \\
z_{okjbad}^{(t,t+1)} &= \sum_{j=1}^n z_{jkjbad}^{(t,t+1)} \lambda_{jk}^t + s_{okjbad}^{(t,t+1)} \quad (k_l = 1, K, nbad_k; \forall k; \forall t) \\
z_{okjfree}^{(t,t+1)} &= \sum_{j=1}^n z_{jkjfree}^{(t,t+1)} \lambda_{jk}^t + s_{okjfree}^{(t,t+1)} \quad (k_l = 1, K, nfree_k; \forall k; \forall t) \\
z_{okjfix}^{(t,t+1)} &= \sum_{j=1}^n z_{jkjfix}^{(t,t+1)} \lambda_{jk}^t \quad (k_l = 1, K, nfix_k; \forall k; \forall t) \\
s_{okjgood}^{(t,t+1)} &\geq 0, s_{okjbad}^{(t,t+1)} \geq 0 \text{ and } s_{okjfree}^{(t,t+1)} : free \quad (\forall k; \forall t)
\end{aligned} \tag{4}$$

The objective function for the overall-efficiency can be expressed by the following program:

$$\Theta = \min \frac{\sum_{t=1}^T W^t \left[\sum_{k=1}^K w^k \left[1 - \frac{1}{m_k + linkin_k + nbad_k} \left(\sum_{i=1}^{m_k} \frac{s_{iok}^{t-}}{x_{iok}^t} + \sum_{(kh)_l=1}^{linkin_k} \frac{s_{o(kh)_l in}^t}{z_{o(kh)_l in}^t} + \sum_{k_l=1}^{nbad_k} \frac{s_{oklbad}^{(t,t+1)}}{z_{oklbad}^{(t,t+1)}} \right) \right] \right]}{\sum_{t=1}^T W^t \left[\sum_{k=1}^K w^k \left[1 + \frac{1}{m_k + linkout_k + ngood_k} \left(\sum_{r=1}^{r_k} \frac{s_{rok}^{t+}}{y_{rok}^t} + \sum_{(kh)_l=1}^{linkout_k} \frac{s_{o(kh)_l out}^t}{z_{o(kh)_l out}^t} + \sum_{k_l=1}^{ngood_k} \frac{s_{oklgood}^{(t,t+1)}}{z_{oklgood}^{(t,t+1)}} \right) \right] \right]} \tag{5}$$

where, W^t ($t=1, \dots, T$) represents the weight to period t and w^k represents the weight to division k . To keep the structure of the paper, we will not report and present further calculations for period efficiency, divisional efficiency and period-divisional efficiency. In our analysis we used for evaluating the efficiency score the mathematical program DEA Solver Pro 13.

4 Results and Discussion

In our analysis we used Dynamic Network Data Envelopment Analysis model with Constant Returns to scale for 35 OECD countries between period 2005-2015. We consider health systems of OECD countries as a DMU. In our paper, the health system consists of two parts: public health system and medical care. In our model we used equal weights for both divisions (0,5 for public health and 0,5 for medical care). Characteristics of inputs and outputs and the definition of all variables, which belong to the divisions are presented in the Table 2. The inputs and outputs have been used in several studies, including basic health determinants as well as medical care characteristics (Ozcan and Khushalani, 2016).

Table 5 Definitions of Variables

Variable	Definition
PUBLIC HEALTH DIVISION	
Inputs	
1 Alcohol consumption	Annual consumption of pure alcohol in liters, per capita, 15+
2 Tobacco consumption	Tobacco consumption, % of population 15+ who are daily smokers
3 Health expenditure	Current expenditure on health, per capita, US\$ (current prices, current PPPs)
Outputs	
4 Life expectancy	Life expectancy, Total population at birth, Years
CARRY OVER	
Bad	
5 Infant mortality	Number of deaths of children aged under 1 year of age, per 1000 live births
Good	
6 Health status	Percentage of the population, aged 15 years old and who report their health to be "good/very good"

LINKS TO MEDICAL CARE	
7 Immunization	Diphtheria, Tetanus, Pertussis; % of children immunized
8 Screening-breast cancer	Breast cancer screening, survey data; % of females aged 50-69 screened
9 Screening-cervical cancer	Cervical cancer screening, survey data; % of females aged 20-69 screened
MEDICAL CARE DIVISION	
<i>Inputs</i>	
10 Medical Technology	Computed Tomography scanners, total, Per million population
11 Employment	Nurses + physicians per 1000 population
12 Beds	Beds per 1000 population
<i>Outputs</i>	
13 Discharges	Discharges per 100 000 population
14 Consults	Number of consultation per capita
BAD CARRY OVER	
15 Cancer	The number of new cancer cases per 100 000 population

Source: prepared by authors

Efficiency scores for selected OECD countries are presented in the Table 3. The table consists of four important columns: overall efficiency score, public health, medical care and Malmquist score, in given period 2005-2015. The overall Malmquist score above 1 point out to the improvement in the efficiency between period in OECD countries.

Table 6 Efficiency Scores for Selected OECD Countries

Country	Overall score		Public Health		Medical Care		Malmquist	
	2005	2015	2005	2015	2005	2015	Overall	Rank
DMU								
Australia	0,7706	0,8576	0,8104	0,9721	0,7245	0,7406	1,1916	8
Austria	1	1	1	1	1	1	0,9246	29
Belgium	0,6538	0,6399	0,7788	0,715	0,5659	0,5809	0,9113	31
Canada	1	1	1	1	1	1	1,1959	6
Chile	1	1	1	1	1	1	1,0045	22
Czech Republic	1	1	1	1	1	1	0,9247	28
Denmark	0,6975	1	0,7478	1	0,6552	1	1,6831	2
Estonia	1	0,8273	1	1	1	0,6866	0,744	35
Finland	1	1	1	1	1	1	0,9778	25
France	0,743	0,6585	0,7722	0,7045	0,7182	0,6195	0,8565	33
Germany	0,7178	0,7773	0,7348	0,7468	0,698	0,814	1,1039	10
Greece	1	1	1	1	1	1	1,2054	5
Hungary	1	1	1	1	1	1	0,9712	26
Iceland	1	1	1	1	1	1	0,978	24
Ireland	0,5137	1	0,7249	1	0,4119	1	1,9942	1
Israel	1	1	1	1	1	1	1,0268	20
Italy	1	1	1	1	1	1	1,047	16
Japan	1	1	1	1	1	1	0,9185	30
Korea	1	1	1	1	1	1	0,902	32
Latvia	1	1	1	1	1	1	1,0187	21
Luxembourg	0,6368	0,7627	0,685	0,7269	0,5976	0,7978	1,1263	9
Mexico	1	1	1	1	1	1	1,0887	12
Netherlands	1	0,7083	1	0,7674	1	0,6602	0,8152	34
New Zealand	1	1	1	1	1	1	1,1933	7
Norway	0,7932	0,8232	1	1	0,6416	0,6719	1,042	17
Poland	0,8119	1	1	1	0,6776	1	1,0903	11
Portugal	1	1	1	1	1	1	0,9563	27
Slovak Republic	1	1	1	1	1	1	1,0331	19
Slovenia	1	1	1	1	1	1	0,9872	23
Spain	1	0,9449	1	0,8897	1	1	1,0807	13
Sweden	1	1	1	1	1	1	1,3612	3
Switzerland	0,4826	0,4922	0,6616	0,6179	0,3698	0,406	1,0406	18
Turkey	1	1	1	1	1	1	1,2665	4
United Kingdom	1	0,9408	1	0,8832	1	1	1,0769	14

United States	1	1	1	1	1	1	1,0544	15
Average	0,9092	0,9266	0,9404	0,9435	0,8874	0,9136	1,0798	-

Source: prepared by authors

The average Malmquist score for the medical care division for the selected countries is 1,1535 and for the public health division is 1,0315. The best score in the improvement of the efficiency showed Ireland, Denmark, Sweden and Turkey over time. Based on the Malmquist score, it is important to mention, that the improvement of the overall efficiency score was driven by better score in efficiency of the medical care as to public health system in Ireland, Denmark, Sweden. The improving of medical care should to be the challenge for Turkey. The same results we can see in other countries. The better improvement we can see in medical care division over time (19 countries vs 16 countries).

Table 7 Projections of Inputs for Selected Countries

Inputs	Average % difference between actual and projected values
PUBLIC HEALTH	
Alcohol consumption	-6,6714
Tobacco consumption	-3,1449
Health expenditure	-3,6071
MEDICAL CARE	
Medical technology	-9,1394
Beds	-7,7206
Employment	-1,4031

Source: prepared by authors

In the Table 4 we present the projections based on DNDEA model for inputs of our sample. This table shows how should to be reduced the inputs to public health system and medical care system based on the projected values. These projections represent average % difference between actual and projected values for achieving the efficiency. From the table can be seen that the inputs to the medical care should to be reduced more than the inputs to the public health system.

5 Conclusions

In this paper we used DNDEA model for assessing the efficiency of health system by the constant returns to scale for selected OECD countries between period 2005-2015. The aim of the paper was to compare the health systems results based on DNDEA model. The DNDEA model consisted of a selection of inputs and outputs for two divisions: the public health system division and the medical care system division. The results of our analysis could be useful for better understanding of current health situation of health policy makers in selected countries. Within the divisions we estimated the efficiency based on 15 variables. The results of our analysis point to improvements in health care in OECD countries. The presented results of efficiency also have some limitations. In the case of missing data in a given year, we included the data that was closest to the given year, which, of course, leads to a bias in the results. Inputs and outputs in health system are very complex. In the literature, there are a number of the other determinants and variables of health system or medical care system, which can be used in DNDEA or other DEA models. The results of either DNDEA models or traditional DEA models are mainly affected by the choice of input and output variables. By including other variables in our model, we can achieve different results.

Acknowledgments

This work was supported by the Slovak Scientific Grant Agency as part of the research project VEGA 1/0794/18.

References

- Banker, R. D., Charnes, A., Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management science*, vol. 30(9), pp. 1078-1092.
- Behr, A., Theune, K. (2017). Health System Efficiency: A Fragmented Picture Based on OECD Data. *PharmacoEconomics-Open*, vol. 1(3), pp. 203-221.
- Charnes, A., Cooper, W. W., Rhodes, E. (1978). Measuring the efficiency of decision making units. *European journal of operational research*, vol. 2(6), pp. 429-444.
- Debreu, G., Arrow, K. J., (1954). Existence of an equilibrium for a competitive economy. *Econometrica: Journal of the Econometric Society*, pp. 265-290.
- Emrouznejad, A., Amin, G. R. (2009). DEA models for ratio data: Convexity consideration. *Applied Mathematical Modelling*, vol. 33(1), pp. 486-498.
- Färe, R., Grosskopf, S. (1997). Intertemporal production frontiers: with dynamic DEA. *Journal of the Operational Research Society*, vol. 48(6), pp. 656-656.
- Färe, R., Grosskopf, S. (2000). Network dea. *Socio-economic planning sciences*, vol. 34(1), pp. 35-49.
- Farell, P. (1957). DEA in production center: An input-output mode. *Journal of Econometrics*, vol. 3, pp. 23-49.
- Hadad, S., Hadad, Y., Simon-Tuval, T. (2013). Determinants of healthcare system's efficiency in OECD countries. *The European journal of health economics*, vol. 14(2), pp. 253-265.
- Jeremic, V., Bulajic, M., Martic, M., Markovic, A., Savic, G., Jeremic, D., Radojicic, Z. (2012). An evaluation of European countries' health systems through distance based analysis. *Hippokratia*, vol. 16(2), pp. 170.
- Kao, C. (2017). *Network Data Envelopment Analysis*. International Series in Operations Research & Management Science. DOI:10.1007/978-3-319-31718-2.
- Kawaguchi, H., Tone, K., Tsutsui, M. (2014). Estimation of the efficiency of Japanese hospitals using a dynamic and network data envelopment analysis model. *Health care management science*, vol. 17(2), pp. 101-112.
- Koopmans, T. C. (1951). Activity analysis of production and allocation. Cowles Commission Monograph No. 13. *John Wiley & Sons, Inc*, vol. 20, pp. 33-97.
- OECD (2017). *Health at a Glance 2017: OECD Indicators*. Paris: OECD Publishing. DOI: http://dx.doi.org/10.1787/health_glance-2017-en.
- Ozcan, Y. A., Khushalani, J. (2017). Assessing efficiency of public health and medical care provision in OECD countries after a decade of reform. *Central European Journal of Operations Research*, vol. 25(2), pp. 325-343.
- Retzlaff-Roberts, D., Chang, C. F., Rubin, R. M. (2004). Technical efficiency in the use of health care resources: a comparison of OECD countries. *Health policy*, vol. 69(1), pp. 55-72.
- Samut, P. K., Cafri, R. (2016). Analysis of the Efficiency Determinants of Health Systems in OECD Countries by DEA and Panel Tobit. *Social Indicators Research*, vol. 129(1), pp. 113-132.

- Sinimole, K. R. (2012). Evaluation of the efficiency of national health systems of the members of World Health Organization. *Leadership in Health Services*, vol. 25(2), pp. 139-150.
- Spinks, J., Hollingsworth, B. (2009). Cross-country comparisons of technical efficiency of health production: a demonstration of pitfalls. *Applied Economics*, vol. 41(4), pp. 417-427.
- Tajnikar, M., Došenović Bonča, P. (2007). Differences between health care systems and the single European health care market. Retrieved from: <https://hrcak.srce.hr/file/28426>.
- Tandon, A., Evans, D. B., Murray, C. J., Lauer, J. A. (2001). Comparative efficiency of national health systems: cross national econometric analysis. *BMj*, vol. 323(7308), pp. 307-310.
- Tone, K., Tsutsui, M. (2009). Network DEA: A slacks-based measure approach. *European journal of operational research*, vol. 197(1), 243-252.
- World Health Organization. (2018). *World health statistics 2018: monitoring health for the SDGs sustainable development goals*. World Health Organization.

Household Deposits' Availability for Credit Institutions during Tensions on Funding Markets – A Case of the Euro Area Countries

Katarzyna Kochaniak

Cracow University of Economics
Department of Finance
27 Rakowicka Street, 31-510 Cracow, Poland
E-mail: katarzyna.kochaniak@uek.krakow.pl

Abstract: *The EU regulations indicate household deposits as stable funding for credit institutions under stress and in the long run. However, the recent financial crisis revealed runs in the euro area, including ones that threatened financial stability. They encouraged to analyse the changes in the levels of deposits placed by households with credit institutions in individual member countries in the period of distress in funding markets. The study aims to analyse the fluctuations in the levels of household deposits and, in particular, to recognise regularities and irregularities in this respect. It applies regression models with time series data on household deposit totals for individual countries in the euro area. The results display considerable cross-country differences in the formation of deposit levels in the period analysed. For several member states, the trend could be recognised only in specified sub-periods. Only for some of the countries, the linear trend described a general long-term direction of changes in household deposit totals, confirming its stability in the entire period. In most member states, seasonal fluctuations in deposit totals occurred, but they related to various months. The study allowed identification of unexpected deposit outflows as well, which resulted, among other reasons, from financial problems of credit institutions. On the other hand, the adjustments in deposit guarantee schemes fostered households' confidence in these entities and led to the unexpected increases of the deposits in selected countries.*

Keywords: *banks' liquidity, household deposits, banks' debt funding*

JEL codes: G21, G32

1 Introduction

The financial crisis has revealed previously underestimated weaknesses of funding models of credit institutions in the EU. They resulted from the growing reliance on wholesale funds, including short-term, and diminishing the importance of retail deposits (Song and Thakor, 2007; Borio, 2009; Brunnermeier, 2009; Fender and McGuire, 2010; Merc et al., 2012; van Rixter and Gasperini, 2013; UKNF, 2017). The period of distress in funding markets led to the revision of the opinion on wholesale funds, drawing attention to their sensitivity to the prevailing conditions. This new, critical view has been strengthened by the EU post-crisis liquidity standards which emphasise the stable nature of retail deposits, both under stress and in the long run (ESRB, 2012; EBA, 2013; European Parliament and Council, 2013; EC, 2015). However, the experience of the last financial crisis provides examples of increased vulnerability of household deposits as well. They were recognised in Belgium, Cyprus, Greece, Spain, Ireland, and Portugal (ECB, 2009; Banco de Espana, 2012; Merck et al., 2012; Central Bank of Cyprus, 2013; Constancio, 2013; Whelan, 2013; National Bank of Greece, 2015).

The literature pays little attention to the formation of household deposit totals and its significance for the liquidity of credit institutions in countries of the single regulatory background. This study aims to fill the existing gap and recognise regularities and irregularities in this respect. Moreover, it refers the empirical results to the EU post-crisis regulatory stance about deposit stability. The paper answers the following research questions:

- Were the aggregated levels of household deposits characterised by a general (long-term) direction of changes in individual countries in the period analysed?

- Could the seasonal changes in household deposit totals be recognised in the euro area member states despite the ongoing destabilisation?
- Were there any unexpected deposit fluctuations during the period analysed?

The paper is organised as follows. Section 2 describes the research method and data applied in the study; Section 3 presents the results of the study; Section 4 contains conclusions.

2 Methodology and Data

The formation in time of household deposit totals (D_t) is an economic process that comprises the general trend (T_t), the economic cycle (C_t), seasonal variation (S_t), and irregular component (ε_t). It can be described as follows:

$$D_t = T_t + C_t + S_t + \varepsilon_t. \quad (1)$$

Due to the length of the period analysed, the study allows determining the trend, seasonal fluctuations, and autoregressive component. The trend defines a general, long-term direction of changes in deposit totals, the seasonality is confirmed by at least one significant parameter of the seasonal variable, and the autoregressive process occurs when the current value of the examined feature results from its value in previous periods. These issues are relevant to assess the formation of household deposit totals in the euro area countries. The study applies the following model (Kufel, 2013):

$$D_t = \sum_{j=0}^r a_j t^j + \sum_{i=1}^{m-1} d_i M_{it} + \sum_{s=1}^p \rho_s e_{t-s} + e'_t, \quad (2)$$

where D_t is the value of household deposits in the sector of credit institutions of a given country (in EUR million) in the t -th unit of time. The unit of time refers to the subsequent months of the analysed period while the value of deposits reflects their value at the end of the month. The first part of the equation relates to j th-degree polynomial whose argument is the time index (t) to isolate the appropriate trend. The second segment captures seasonal fluctuations in deposit values using dummy variables (M_i) identifying the months from January to November (December is the basis for comparison). The third part refers to autoregressive residues from the model (3); a, d, ρ - structural parameters of the model.

$$D_t = \sum_{j=0}^r a_j t^j + \sum_{i=1}^{m-1} d_i M_{it} + e_t \quad (3)$$

The OLS is applied to estimate of the structural parameters of the models. However, GLS is used in the case of heteroscedasticity (Kufel, 2013), according to heteroscedasticity consistent covariance matrix (HCCM). The goodness-of-fit of the models to empirical data is tested by the Akaike criterion (AIC), the Schwartz-Bayes information criterion (SBC), and the coefficient of determination (R^2) (Gorecki, 2010). The variance inflation factor (VIF) is used to check the collinearity of independent variables, and the White's test to verify the homoscedasticity of the variance (Kufel, 2013). The t-Student test is applied to assess the significance of structural parameters of the models, while the Doornik-Hansen test is to assess the normality of the distribution of residues (Kufel, 2013).

The study uses monthly data on household deposit totals placed with credit institution sectors of the euro area. They are derived from the ECB's and national central banks' database, "Our statistics", for the period of distress in funding markets. In most cases, this time span lasts from August 2007 to December 2014. However, in the case of Cyprus, Greece, Portugal, and Italy, it is extended until December 2016 due to the continuing funding problems of domestic credit institutions. The limited data for Estonia and Latvia led to the adoption of shortened periods for them (from January 2008 to December 2014 and from September 2010 to December 2014, respectively).

3 Results and Discussion

The analysis of the formation of household deposit totals in individual euro area countries was carried out using the model (2). In the case of Cyprus, Ireland, and Luxembourg, its specification was only possible in sub-periods, which referred to August 2007 - December 2012, January 2009 - December 2014, and May 2008 - December 2014, respectively. Due to the severe economic and financial problems of Greece, the analysis conducted for this country was limited to the estimation of a trend for specified sub-periods. In its case, the reliance on international aid programs and the persisting political problems triggered immediate reactions by depositors, who were withdrawing the deposits from domestic banks. The above limitations of the study prove significant cross-country differences in the formation of deposit totals in the euro area.

The first critical issue in this study was the choice of the polynomial degree of the time variable. The linear trend was adopted in the models for most countries (i.e., Belgium, Cyprus, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, the Netherlands, and Spain). Intercept and parameter estimate of the time variable informed about the differences in the availability of household deposits for credit institutions among the countries regarding their initial levels and average monthly changes in the period analysed. However, an upward trend was recognised in all of them except for Ireland, where for the sub-period December 2009 to December 2014, the trend was negative. Concerning the remaining countries - Austria, Lithuania, Luxemburg, Portugal, Slovakia, and Slovenia - second-degree polynomial for the time variable was adopted. The German sector certainly stood out with the intercept reaching almost EUR 1,500,000,000,000 and the coefficient of time variable exceeding EUR 5,600,000,000. Also, the French sector distinguished itself with the intercept equal to over EUR 950,000,000,000 and the trend coefficient of almost EUR 3,400,000,000. Subsequently, the attention should be drawn to Italian sector (over EUR 750,000,000,000 and EUR 2,400,000,000 respectively) and the Spanish sector (almost EUR 650,000,000,000 and EUR 1,500,000,000 respectively). On the other hand, there were relatively small countries with significantly lower deposit levels like Estonia with the intercept of slightly over EUR 3,000,000,000 and trend coefficient equal to EUR 27,000,000, Latvia with values of almost EUR 4,000,000,000 and EUR 22,000,000 respectively, or Malta with the values of almost EUR 6,000,000,000 and almost EUR 30,000,000 respectively. On the basis of the levels of the intercept it can be stated that with the beginning of the crisis, the availability of this funding was generally adequate to the size of domestic sectors of credit institutions.

The parameter estimates confirmed the occurrence of seasonal changes in the deposit levels in all countries analysed, except for Greece (Table 1). Regarding the dummies identifying individual months, at least three of them were statistically significant in each model. The least susceptible to seasonal fluctuations were the deposits placed in Austria, France, Ireland, and Luxembourg. It should be emphasised that, in Austria, the most significant monthly outflows of deposits accounted for only 1.4% of the average value of the deposits in the analysed period. While comparing the seasonality of deposit totals in each month, it can be stated that in January they were close to those in December (the basis for comparison). In January, a seasonality was recognised only in Belgium, Lithuania, Malta, the Netherlands, Slovakia and Slovenia. However, for the Slovenian sector, this amplitude was the highest during the entire year. Most models (except for Austria, France, and Luxembourg) confirmed the seasonal fluctuations of the deposits in July. Regarding Estonia and Portugal, they led to utmost changes in their availability for credit institutions. Moreover, in June, household deposit totals were subject to significant adjustments. The positive ones were observed in Belgium, Cyprus, Estonia, Finland, the Netherlands, and Spain. This phenomenon resulted from bonus payments to employees before the summer vacation season, among other factors (DeNederlandscheBank, 2016). It is worth noting that September was a month of substantial negative seasonal changes in the deposit levels. The limited availability of this funding occurred then in, e.g. Austria, Germany, Italy, Latvia, Lithuania, and Portugal. The same could be concluded regarding November, when the deposits outflowed from the sectors of credit institutions in, e.g. Belgium, Cyprus, Estonia, Finland, France, Ireland, Italy, Lithuania, Slovakia, and Spain. In October, large deposit

withdrawals were observable in, e.g. Finland, France, Germany, Italy, Portugal, Slovakia, and Spain. For selected countries, the statistical significance of the parameter estimates of the dummies representing seasonal changes in deposit totals from January to November allowed estimating the ones that occurred in December each year. They led to conclusions about deposit outflows at the end of each year from credit institutions located in Belgium, Cyprus, Estonia, Finland, Luxembourg, the Netherlands, and Slovenia. They were caused, among other factors, by increasing expenditures of households during the Christmas and New Year period, as well as estimations of their capital gains taxes based on deposit levels at the end of the year (in the case of the Netherlands). In turn, the deposit accumulation in December was recognised in Germany, Italy, Latvia, Lithuania, Malta, Portugal, and Slovakia..

In selected countries of the euro area, solely positive or negative seasonal changes in deposit levels could be observed (Table 1). The only negative estimates were recognised in the models for Austria, Germany, Ireland, Italy, Lithuania, Latvia, and Malta. Thus, they informed about the largest availability of household deposits for credit institutions in December each year. The opposite could be concluded regarding Luxembourg, the Netherlands, and Slovenia. In the Netherlands and Slovenia, the elevated amounts of the deposits were recorded in most months. The results in Table 1 also draw attention to Belgian, Cypriot, Estonian, Finnish and Slovakian households who in general displayed an increased propensity to accumulate the deposits in the first half of a year and to withdraw them in the second.

In selected credit institution sectors, certain irregularities regarding deposit formation could be identified. They related to sudden inflows or outflows of the deposits in monthly periods. Due to their occurrence, the dummies relating to specific months entered the models and allowed estimating the dimension of these phenomena. Such adjustments were carried out for Belgium, Cyprus, Estonia, the Netherlands, Lithuania, Latvia, Germany, Slovakia, Slovenia, and Italy. In Lithuania, October 2008 and December 2011 emerged as months characterised by deposit outflows equal to EUR 414,500,000 and EUR 581,700,000, and December 2014 as a month with an increased value of the deposits by EUR 419,600,000. It should be emphasised that both negative changes resulted from a loss of confidence of depositors (households) in credit institutions caused by the bankruptcy of Snoras (one of the largest banks in Lithuania) and liquidity problems of the sector, including its limited access to market funding (IMF, 2009). On the other hand, a substantial increase in the deposits in December 2014 should primarily be linked to the accession of Lithuania to the euro area. In Slovakia, December of 2008 turned out to be the month of massive unexpected inflows of the deposits as well as October and November of 2008. The abandonment of the limit within the deposit guarantee scheme could explain the unusually high level of the deposits in the last quarter of 2008. In Belgium, irregular units of time with negative effects on deposit totals became apparent in December 2011 and May 2014 due to the problems of Dexia, including a rescue package provided for this bank by the governments of Belgium, France, and Luxembourg. In Cyprus, the last month of 2016 turned out to be distinctive due to a vast increase in the aggregated level of deposits resulting from the boosted confidence of depositors in credit institutions and elevated interest rates in this country (IMF, 2017). In the Netherlands, December 2014 represented a month of reduced deposit totals due to households looking for alternative investment opportunities of a higher rate of return (DeNederlandscheBank, 2016). In Latvia, November 2011 and December 2013 significantly differed from the remaining months. Regarding the first one, the decreased level of deposits resulted from households' reaction to the insolvency of JSC Latvijas Krājbanka and commencement of deposit repayments from the national deposit guarantee scheme. In December 2013, the value of households' deposits, in turn, was higher and could be explained by the adoption of the single currency by this country. It is worth noting that it was the most substantial increase in deposits since the beginning of the financial crisis. In Germany, irregularities in deposit totals were recognised in October 2008. The remarkably higher level of deposits resulted from the increased limit in the deposit guarantee scheme. In Italy, unexpected significant deposit inflows happened in October, November, and December 2008. The last quarter of

2008 can, therefore, be seen as conducive to the accumulation of deposits by Italian households, which resulted from the elevated guarantee limit. In Estonia, irregular positive changes in deposit totals were recognised in December 2010 due to a new deposit guarantee limit and Estonia's entry into the euro area. However, January 2013 was identified as a month of a statistically significant decrease in deposit totals caused by low interest rates, which discouraged households from holding them.

Table 1 Seasonal Fluctuations in the Total Value of Household Deposits in Plus and Minus in Individual Months in the Sectors of Credit Institutions

Country	Months										
	1	2	3	4	5	6	7	8	9	10	11
AT	x	(-)	x	x	x	x	x	(-)!	(-) !!	x	(-)
BE	(+)	(+)	(+)	(+)	(+) !!	(+) !	(+)	x	x	x	(-) !!
CY	x	(+)	x	(+)	(+) !	(+) !!	(+)	x	x	x	(-)!!
DE	x	x	(-)	x	x	(-)	(-)	(-)	(-) !!	(-) !	x
EE	x	(+)	x	(+)	(+)	(+) !	(+) !!	(+)	x	x	(-) !!
ES	x	x	x	x	x	(+) !!	(+) !	x	(-)	(-) !!	(-) !
FI	x	x	x	(+) !	(+)	(+) !!	(+)	(+)	x	(-) !	(-) !!
FR	x	x	x	(+) !!	x	x	x	x	(-)	(-) !	(-) !!
IE	x	x	(-)	x	x	x	(-) !	x	x	x	(-) !!
IT	x	(-)	(-)	x	x	x	(-)	(-)	(-) !	(-) !!	(-)
LT	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-) !!	(-)	(-) !
LU	x	(+) !!	(+)	(+)	(+) !	x	x	x	x	x	x
LV	x	x	(-)	(-)	(-)	(-)	(-)	(-) !!	(-) !	(-)	x
MT	(-)	(-)	(-) !	(-)	(-) !!	(-)	(-)	(-)	(-)	(-)	x
NL	(+)	(+)	(+)	(+)	(+)	(+) !!	(+) !	(+)	(+)	(+)	x
PT	x	x	(-)	(-)	(-)	x	(+) !!	x	(-) !	(-) !!	x
SI	(+) !!	(+) !	(+)	x	(+)	(+)	(+)	(+)	x	x	x
SK	(+) !	(+) !!	(+)	(+)	x	x	(-)	(-)	(-)	(-) !	(-) !!

Notes: (+) - positive parameter estimate, (-) - negative parameter estimate, (!!) - the highest amplitude of seasonal fluctuations among all positive/negative monthly amplitudes, (!) - second the highest amplitude of seasonal fluctuations among all positive/negative monthly amplitudes.

Source: own study based on results from the model (2).

The last part of the model (2) refers to the autoregressive component. It allowed concluding about the statistical significance of developments in deposit totals from past months for the current level of deposits in the countries analysed (Table 2). The links between the levels of the deposits in the current month and previous month were recognised as the sole one in the models for Austria, Belgium, Cyprus, Spain, Lithuania, Luxembourg, Malta and Slovakia. Regarding the remaining countries, the influences of more distant months were observable as well. They could result from the flows of household saving deposits.

Table 2 Statistically Significant Delays of Residues from Models (2) of the Formation of Household Deposit Totals in Credit Institution Sectors of the Euro Area

Country	Delay in months											
	1	2	3	4	5	6	7	8	9	10	11	12
AT	(+)	x	x	x	x	x	x	x	x	x	x	x
BE	(+)	x	x	x	x	x	x	x	x	x	x	x
CY	(+)	x	x	x	x	x	x	x	x	x	x	x
DE	(+)	x	(+)	(-)	x	x	x	x	x	x	(+)	(-)
EE	(+)	x	x	x	x	x	x	x	x	x	x	x
ES	(+)	x	x	x	x	x	x	x	x	x	x	x
FI	(+)	x	x	(-)	x	x	x	x	(+)	(-)	x	x
FR	(+)	x	(+)	(-)	x	x	x	x	x	x	x	x

IE	(+)	x	x	x	x	x	(-)	x	x	x	x	x
IT	(+)	x	x	x	x	x	x	x	x	x	(+)	x
LT	(+)	x	x	x	x	x	x	x	x	x	x	x
LU	(+)	x	x	x	x	x	x	x	x	x	x	x
LV	(+)	x	(+)	x	x	x	x	x	x	x	x	x
MT	(+)	x	x	x	x	x	x	x	x	x	x	x
NL	(+)	x	x	x	x	x	x	x	(+)	(-)	x	x
PT	(+)	x	x	(-)	x	x	x	x	x	x	x	x
SI	(+)	x	x	x	x	x	x	x	x	(-)	(+)	(-)
SK	(+)	x	x	x	x	x	x	x	x	x	x	x

Notes: (+) - positive parameter estimate, (-) - negative parameter estimate.

Source: own study based on results from the model (2).

4 Conclusions

The results of modelling the process of household deposit allocation in the euro area countries allowed to refer them to the EU single regulations, which emphasise the stable nature of retail deposits under stress and in the long run. They served to formulate the following conclusions:

- The process of deposit allocation in credit institution sectors of the euro area was not uniform in the period of tensions in funding markets. The differences in the availability of household deposits in the long term, as well as in its monthly fluctuations, drew attention to the limited adequacy of the single regulatory stance regarding the euro area countries.
- In the models for most countries, the time variable was linear. Only in their cases can we, therefore, conclude the constancy of the general direction of the value of the deposits in the period analysed. Increasing deposit totals in the sectors of credit institutions of these countries confirmed their long-term availability and, thus, their stability as funding for credit institutions, despite the evolving destabilisation.
- In the remaining sectors, the direction of changes in household deposit totals was described with a second-degree polynomial. Thus, regarding the entire period analysed, it was possible to distinguish two sub-periods characterised by the opposite direction of changes in the availability of the deposits for credit institutions. In one of them, a gradual decrease in deposit totals was observed, emphasising the need for credit institutions to rely more on funding from other sources, which were difficult to obtain on a dysfunctional financial market. Thus, the changes observed in deposit totals were not in line with the regulatory stance on the availability of deposits in the long run. Regarding the second subperiod, the deposit inflows were conducive to their availability for credit institutions. These results led to conclusions that the general direction of changes in deposit totals might be responsible for the modifications of the models of funding of credit institutions throughout the study period.
- In most sectors of credit institutions in the euro area, the levels of household deposits were subject to seasonal fluctuations. It should be noted that the recognised fluctuations occurred on a monthly basis and had a repetitive nature despite the instability. The changes in deposit totals were therefore predictable and regular throughout the analysed period regardless of the phase of the financial crisis. The positive mid-year and end-year fluctuations were revealed in selected countries. It should be emphasised that in some sectors, the amplitude of fluctuations in the level of deposits was negative and occurred, among others, in December. The knowledge on the seasonality of changes in deposit values—in particular, those related to outflows—is essential for liquidity management in credit institutions.
- In the models for selected countries, irregular time units were identified in which excessive flows of household deposits resulted from extraordinary, unpredictable events. The sudden increase in deposits was caused by, among other phenomena, increased trust in governments and public institutions, both domestically and within the euro area. They occurred in selected sectors after the announcement of changes in deposit guarantee schemes, referring to the increase or abandonment of the limits, as

well as after the accession of selected countries to the euro area. However, attention should be paid, in particular, to these irregular time units that identified sudden outflows of deposits. They occurred, among other situations, under the lack of depositors' confidence in credit institutions. All the runs identified in this study related to large credit institutions and were visible at the country level. In their case, the limited stability of household deposits under stress should be therefore concluded.

- In all credit institution sectors, the availability of household deposits in a given month was positively affected by their increasing value in the previous month. This conclusion seems essential for the management of short-term liquidity of credit institutions, according to the LCR standard.

Acknowledgments

The paper presents the results of a study carried out under a research project financially supported by the National Science Centre in Poland (grant number: DEC-2013/11/D/HS4/04056).

References

Banco de Espana (2012). *Analysis of recent changes in bank deposits in Spain*. Retrived from: https://www.bde.es/f/webbde/SES/Secciones/Publicaciones/Publicaciones/InformesBoletinesRevistas/BoletinEconomico/12/Sep/Files/be1209e_art2.pdf.

Borio, C. (2009). Ten propositions about liquidity crises. *BIS Working Paper*, vol. 293, pp. 1-21.

Brunnermeier, M. K. (2009). Deciphering the Liquidity and Credit Crunch 2007-2008. *Journal of Economic Perspectives*, vol. 23(1), pp. 77-100.

Central Bank of Cyprus (2013). *Cyprus Financial Assistance Programme – Memoranda signed with the EU and the International Monetary Fund: Q&A regarding the financial sector*. Retrieved from: https://www.centralbank.cy/media/2013-08-13_QA_English_comments.pdf.

Commission Delegated Regulation (EU) 2015/61 of 10 October 2014 to supplement Regulation (EU) No 575/2013 of the European Parliament and the Council with regard to liquidity coverage requirement for Credit Institutions.

Constancio V. (2013). *Fragmentation and rebalancing in the euro area*. Retrieved from: <https://www.ecb.europa.eu/press/key/date/2013/html/index.en.html>.

DeNederlandscheBank (2016). *Dutch household savings increase further, net deposits decline*. Retrieved from: <https://www.dnb.nl/en/news/news-and-archive/statistisch-nieuws-2016/index.jsp>.

EBA (2013). *Draft Guidelines on retail deposits subject to different outflows for purposes of liquidity reporting under CRR - Public Hearing*. EBA Consultation Paper, London: EBA.

ECB (2009). *EU banks' funding structures and policies*. Retrieved from: <https://www.ecb.europa.eu/pub/pdf/other/eubanksfundingstructurespolicies0905en.pdf?2061889f5f5b13af941c033793d868b2>.

Fender, I., McGuire, P. (2010). Bank structure, funding risk and the transition of shocks across countries: concepts and measurement. *BIS Quarterly Review*, September, pp. 63-79.

Gorecki B.R. (2010). *Podstawowy kurs nowoczesnej ekonometrii*. Retrived from: <http://docplayer.pl/storage/17/137130/1494434439/bOeUBMqwoB0ga-hbla2KOQ/137130.pdf>.

IMF (2009). *Republic of Lithuania: Staff Report for the 2009 Article IV Consultation*. IMF Country Report No. 09/322. Retrived from: <https://www.imf.org/en/Publications/>

CR/Issues/2016/12/31/Republic-of-Lithuania-Staff-Report-for-the-2009-Article-IV-Consultation-23437.

IMF (2017). *Cyprus: First Post-Program Monitoring Discussions – press Release; Staff Report; and Statement by the Executive Director for Cyprus*. IMF Country Report 17/148. Retrived from: <https://www.imf.org/en/Publications/CR/Issues/2017/06/08/Cyprus-First-Post-Program-Monitoring-Discussions-Press-Release-Staff-Report-and-Statement-by-44976>.

Kufel, T. (2013). *Ekonometria. Rozwiązywanie problemów z wykorzystaniem programu GRETL*. Warszawa: Wydawnictwo Naukowe PWN.

Merc, M. M., Van Rixtel, A., Mota, E. G. (2012). Business models of international banks in the wake of the 2007-2009 global financial crisis. *Banco de España Revista de Estabilidad Financiera*, no. 22, pp. 100-121.

National Bank of Greece (2015). *Group and Bank Interim Financial Report*. Retrieved from: https://www.nbg.gr/english/the-group/investor-relations/financial-information/annual-interim-financial-statements/Documents/Annual%20and%20interim%20financial%20statements/Financial%20Report%2030%2006%202015%20EN%20_%20FINANCIAL.pdf.

Recommendation of the European Systemic Risk Board of 20 December 2012 on funding of credit institutions (ESRB/2012/2).

Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) NO 648/2012.

Song, F., Thakor, A.V. (2007). Relationship Banking, Fragility, and the Asset-Liability Matching Problem. *Review of Financial Studies*, 20(6), pp. 2129–2177.

UKNF (2017). *Metodyka badania i oceny nadzorczej banków komercyjnych, zrzeszających oraz spółdzielczych (metodyka BION)*. Retrived from: https://www.knf.gov.pl/knf/pl/komponenty/img/knf_177735_metodyka_bion_banki_2017_53997.pdf.

Van Rixter, A., Gasperini, G. (2013). Financial crisis and bank funding: recent experience in the euro area. *BIS Working Paper*, no. 406, pp. 1-30.

Whelan, K. (2013). *Ireland's Economic Crisis. The Good, the Bad and the Ugly*. Retrieved from: <http://www.karlwhelan.com/Papers/Whelan-IrelandPaper-June2013.pdf>.

Motives of Households for Saving in Poland

Anna Magdalena Korzeniowska

Maria Curie-Skłodowska University in Lublin
Faculty of Economics, Department of Banking
Pl. Marii Curie-Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: anna.korzeniowska@umcs.lublin.pl

Abstract: According to J. M. Keynes' theory of saving in the economy and households' behaviour followed by M. Browning and A. Lusardi (1996), the main motives for people to save are the precautionary motive, the life-cycle motive, the intertemporal substitution motive, the improvement motive, the independence motive, the enterprise motive, the bequest motive, the avarice motive and the down payment motive. This article examines which motives prevail in the decisions of Polish households in terms of saving. A sample of 223 working respondents was taken under consideration. Each of them represents a household from Lubelskie Voivodeship (Poland). The research proves that the precautionary motive has the highest ranking in respondents' opinions followed by the independence motive. The down payment motive was ranked lowest, closely followed by the enterprise motive. Additionally, analysis of correlation between motives was carried out. In most cases, there is a statistically significant correlation between saving motives. However, although the respondents rated saving motives highly, their impact on respondents' saving behaviour is lower than can be assumed.

Keywords: saving motives, saving behaviour, personal saving

JEL codes: D14, E21

1 Introduction

Saving is a process of putting away some resources to preserve them for future use. The process can be run either putting consciously or unconsciously. The latter occurs, e.g. when at the end of a certain period, some unplanned surplus is available. The saving process is the subject of intense consideration in different trends of economics. Many researchers and scientists are interested enough in saving and its motives to include it as part of their economic theories. Among them were J. M. Keynes, who focused on current income, F. Modigliani, the author of the life-cycle hypothesis of saving and M. Friedman, who worked on the permanent income hypothesis. J. Duesenberry and a large group of other researchers state that the saving behaviour of households is determined mostly by psychological and sociological determinants. Duesenberry emphasizes that saving behaviour of an individual is influenced by that person's peers. Others focus on personal traits such as aversion to risk, habits and attitudes as factors of saving. They often take into consideration socio-economical qualities of savers, e.g. gender, age, location, income, etc. These points of view were presented in the works of G. Katona, who also suggested that past experience in saving influences the likelihood of doing it in the future (Devaney, Anong, Whirl, 2007).

The aim of this article is to analyse which motives determined by Keynes, in terms of saving, prevail in the decisions of Polish households.

2 Saving motives in theories of economy

In his work published in 1981, Alf Lindqvist pointed out that socioeconomic variables and those variables specifically that are important in economic theories may not be related to bank saving. During the regression analysis, the variables assumed to be important predictors of saving showed no predictive value (Lindqvist, 1981). This research inspired other scientists to search for and analyse the determinants and motives of saving.

On the basis of Maslow's hierarchy of needs, some researchers studied motives that influence saving behaviour simultaneously (Xiao, Noring, 1994). In 1998, Boeree ranked

saving motives by their importance, from lowest to highest: physiological (basic), safety, security, love/societal, esteem/luxuries and self-actualization (Devaney et al., 2007). Generally, when the lower level needs are met, an individual one tends to move up to higher ones in the hierarchy. The perception of importance and significance of saving motives depends mostly on age and wealth of individuals (Yao, et. al., 2011)

Following J. M. Keynes' theory of saving in economy and households' behaviour with regard to this, M. Browning and A. Lusardi (1996) produced a list of eight household saving motives with one addition: the precautionary motive, the life-cycle motive, the intertemporal substitution motive, the improvement motive, the independence motive, the enterprise motive, the bequest motive, the avarice motive and the down payment motive. However, research scientists had already observed the need to analyse these motives while considering heterogeneity of members of populations and changes that can occur in the motives of the same person over the long run (Browning, Lusardi, 1996).

The importance attributed to saving motives can determine or at least influence the household saving rate. Additionally, the relative contribution of the saving motive to household saving changes with age. What is more, the importance that households attach to different saving motives is correlated with observed saving behaviour (Schunk, 2009). But scientist also determined that there is vast heterogeneity between households from different regions, cultures and age groups when it comes to the hierarchy of saving motives and the strength of their influence on saving (Canova et al., 2003).

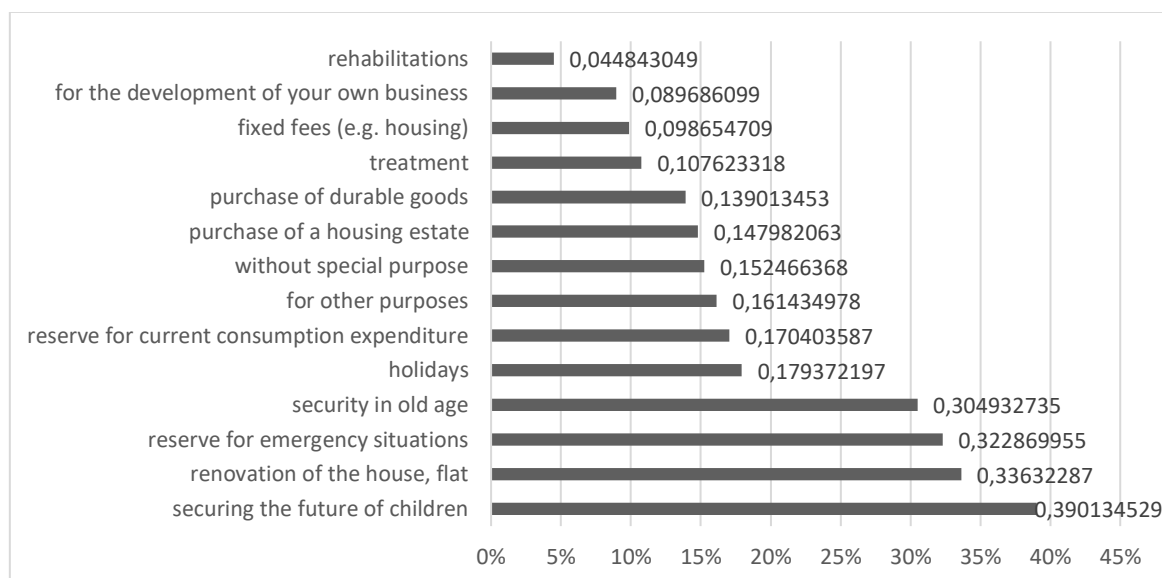
3 Goals and motives of saving in Poland

In research carried out at the beginning of 2018, a sample of 223 working respondents was considered. Each represented a household from Lubelskie Voivodeship (Poland). The respondents differed in gender, age, location and the level of education. They also declared the size of their household measured by the number of members, and they were asked to assess their financial situation. In all, 57% of respondents were women, and more than 55% of respondents were 26 to 35 and 36 to 45 years old. The same percentage, 30%, was recorded for those respondents living in rural areas and in cities with more than 200,000 citizens. Those having one to three other members in their households, respectively, were within a group of 26% to 28% respondents. As for their economic situations, approximately 50% assessed it as average. Almost 80% hold permanent employment, while 12% run their own businesses or were self-employed. In all, 35% graduated from high school, 24.5% hold bachelor's or engineering degrees and 34.5% were university graduates.

The respondents were asked to choose all their goals of saving from the provided list (Fig. 1). The largest group (39.01%) identified their saving goal as preserving money for their children. The Pearson coefficient between this goal and bequest motive is $r=0.346$ ($p\text{-value}=0.000$; with significance threshold 0.01). The next three goals indicated by more than 30% of the respondents were renovation of housing estate, reserve for random situations and providing security in old age. The second one is correlated with the precautionary motive with $r=0.165$ ($p\text{-value}=0.033$, $\text{sign.}=0.05$), and the last one is correlated with the life-cycle motive with $r=0.166$ ($p=0.023$, $\text{sign.}=0.05$).

Both the improvement and the independence motives are statistically significantly correlated with purchasing own housing, with $r=0.218$ ($p=0.003$, $\text{sign. } 0.01$) and $r=0.159$ ($p=0.036$, $\text{sign. } 0.05$), respectively. Although only 8.97% of the respondents declared they were saving for opening or developing their own business, that goal is strongly correlated with the enterprise motive with $r=0.270$ ($p=0.000$, $\text{sign.}=0.01$).

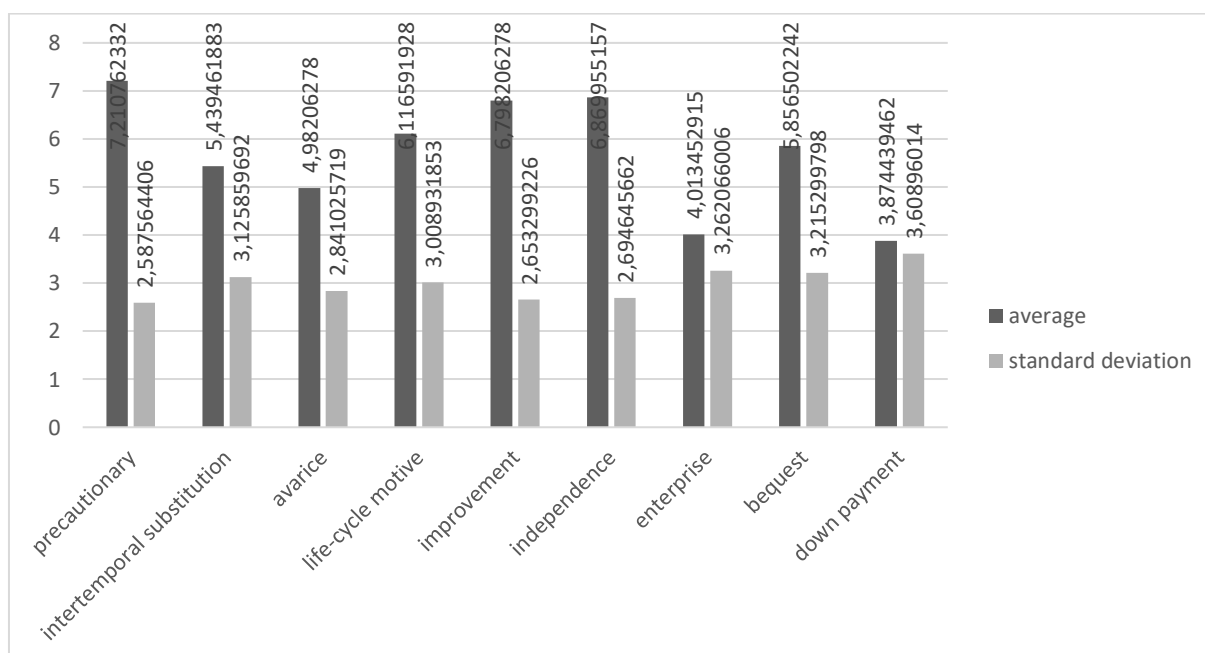
Figure 1. Goals of Saving (Multiple Choice)



Source: own calculations on the basis of questionnaire

The research proves that the precautionary motive has the highest ranking in the respondents' opinions, with the average mark 7.21 in the ascending scale from 0 to 10, followed by the independent and improvement motives with marks of 6.87 and 6.80, respectively (Fig. 2). The lowest ranking refers to the down payment motive with an average assessment of only 3.87, closely followed by the enterprise motive with an average mark of 4.01. The standard deviation of the mark for both these latter motives is the highest, which indicates large differences in respondents' opinions about these motives' importance.

Figure 2. Importance of Saving Motives (0—not important, 10—extremely important)



Source: own calculations on the basis of questionnaire

The relatively high value of averages indicates the importance of these saving motives for Polish households. However, the low correlation between saving motives and actual goals

of saving may imply that either households do not follow their motives or other important factors influence the choice of saving goals.

Furthermore, analysis of correlation between saving motives was carried out. In most cases, there is a statistically significant correlation between saving motives (Table 1). The highest correlation ($r=0.654$) occurred between the life-cycle motive and the bequest motive, followed by the correlation between the improvement and independence motives ($r=0.537$) and the independent and precautionary motives ($r=0.501$). However, no significant correlation was found between the down payment motive and the precautionary, improvement or independence motives. There is also a lack of correlation between the enterprise and precautionary motives and between the bequest and avarice motives.

Table 1. Pearson's Coefficient Between Saving and Saving Motives

	precautionary motive	intertemporal substitution motive	avarice motive	life-cycle motive	improvement motive	independence motive	enterprise motive	bequest motive	down payment motive
precautionary motive	1	.300**	.219**	.471**	.501**	.366**	.147	.291**	.123
intertemporal substitution motive	.300**	1	.384**	.454**	.345**	.234**	.397**	.373**	.237**
avarice motive	.219**	.384**	1	.245**	.182*	.259**	.159*	.137	.197**
life-cycle motive	.471**	.454**	.245**	1	.424**	.309**	.332**	.654**	.236**
improvement motive	.501**	.345**	.182*	.424**	1	.537**	.307**	.223**	.147
independence motive	.366**	.234**	.259**	.309**	.537**	1	.220**	.174*	.152
enterprise motive	.147	.397**	.159*	.332**	.307**	.220**	1	.306**	.203**
bequest motive	.291**	.373**	.137	.654**	.223**	.174*	.306**	1	.256**
down payment motive	.123	.237**	.197**	.236**	.147	.152	.203**	.256**	1

* - refers to $p=0.05$

** - refers to $p=0.01$

Source: own calculations on the basis of the questionnaire

4 Relationship between saving and its motives

To compare saving behaviour of the respondents with their saving motives, cross tables and the correspondence analysis with symmetrical normalisation were calculated. Correspondence analysis allows presenting results in graphic form as a chart of dispersion in which the points present particular categories of variables. The results proved to be statistically significant only for three motives: precautionary, improvement and life-cycle. In the case of both the precautionary and improvement motives, the first two dimensions of the correspondence analysis cover more than 70% of the results. While the importance of motives was assessed on an ascending scale from 0 to 10, the list of answers to the question about saving behaviour was:

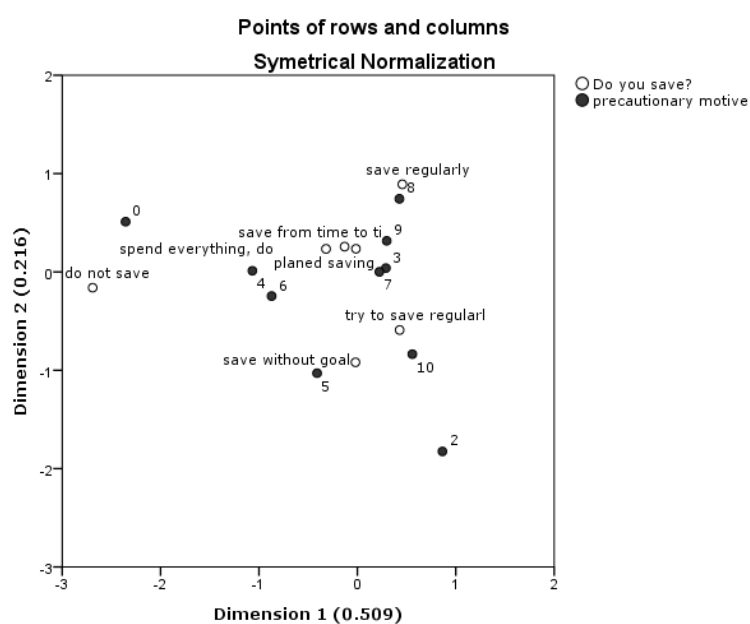
- I do not save,
- I spend everything on current needs, do not put off anything, do not invest (spend everything),
- I usually devote everything to current needs, but from time to time, I manage to save something (save from time to time),

- in addition to current expenses, I try to save some funds on regular basis (try to save regularly),
- I save a certain amount of money in addition to current expenses each month (save regularly),
- I allocate funds for consumption and savings in advance, but I have no specific purpose to save and plan to use financial instruments (save without a goal), and
- in advance, I allocate funds for consumption and savings, which I invest in planned financial instruments (planned saving).

The analysis shows that Polish households do not save with a proper plan. The largest group consisting of 34.08% of the respondents are those who try to save regularly. Another group of 25.11% of the respondents saves only from time to time after having satisfied their basic needs. Certain amounts of money are regularly put away by 17.49%. The respondents allocating set amounts of income to saving in advance are in the minority. In all, 6.73% save intentionally but without a goal or a saving plan, and 5.38% have some saving strategy. More than 11% of the respondents do not save at all.

The analysis reveals various patterns in households' behaviour. In the case of the precautionary motive, both the 0 and the 2 marks stand out, which indicates evidently that this motive is extremely important and is placed close to those who make an effort to save regularly (Fig. 3). Some who save regularly set amounts of money, but they do not have fixed goals, so they tend to follow this attitude, while the rest of them seem to have assessed the importance of the precautionary motive as an average "5" within the ranking. The respondents who allocate their funds in advance and have plans to utilise specific financial instruments to increase their wealth and those who manage to save some amounts from time to time (which in G. Katona's classification would be contractual saving and residual saving, respectively) (Fisher, Anong, 2012), the precautionary motive has varied importance. Some give it a rather low mark of "3", while others attributed to it higher ratings of "7" and "9". The largest group of regular savers is very close to mark "8". Interestingly enough, the declaration about not saving in the case of the precautionary motive is close to "0", while the improvement motive is closer to ratings "3" and "4" (Fig. 4).

Figure 3. Correspondence Analysis of the Saving Behaviour vs the Precautionary Motive

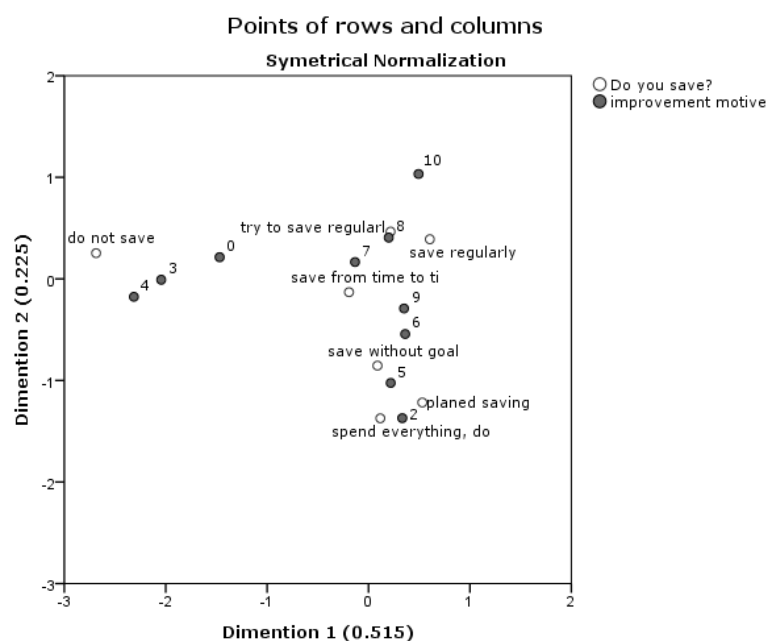


$\chi^2=80.497$, $p\text{-value}=0.04$ (60 degrees of freedom)

Source: own calculations with the usage of IBM SPSS on the basis of the questionnaire

In Fig. 4, which represents the correspondence between the saving behaviour and the improvement motive, we can observe a very distinctive pattern. The more regular the saving, the more important the improvement motive is, with the exclusion of planned saving. The improvement motive includes saving for different real assets and services such as real estate satisfying the housing requirements of the household, a car, up-to-date furnishings and household equipment, and an education in the form of extra courses or studies. The implied need to save with the intention to spend money on specific planned goals forces savers to allocate their money regularly or at least semi-regularly. The analysis proves a real correspondence of saving behaviour with the improvement motive.

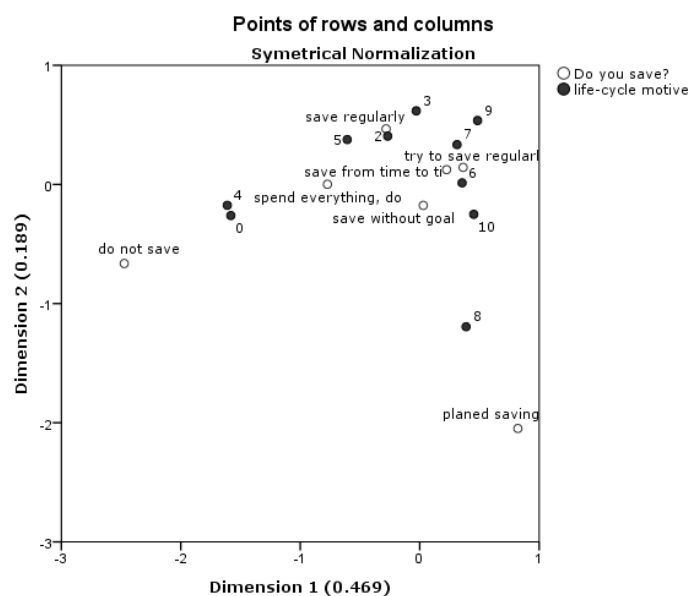
Figure 4. Correspondence Analysis of Saving Behaviour vs Improvement Motive



$\chi^2=87.245$, $p\text{-value}=0.012$ (60 degrees of freedom)

Source: own calculations with the usage of IBM SPSS on the basis of questionnaire

Figure 5. Correspondence Analysis of Saving Behaviour vs Life-cycle Motive



$\chi^2=87.783$, $p\text{-value}=0.011$ (60 degrees of freedom)

Source: own calculations with the usage of IBM SPSS on the basis of questionnaire

The first two dimensions in the correspondence analysis of saving behaviour vs the life-cycle motive cover roughly 65.8% of the results (Fig. 5). This motive of saving is not important for people who do not save. It is also one of the less important saving motives for these who allocate and invest their saving with a plan. Out of all correspondence analysis between saving behaviour and the importance of the life-saving motive, the answers are the most concentrated in one place on the figure. This suggests that although life-cycle motive is not the most important for respondents, it is considered significant regardless of their saving behaviour. The results may also suggest that Polish households do not know how or do not have proper instruments to save in the long term because the life-cycle motive requires low risk stable instruments such as insurance policies, pension plans, and long-term deposits.

5 Conclusions

These findings indicate that Polish households understand the importance of saving to provide financial security for themselves and their descendants. They are aware of the implications of saving inspired by the improvement motive. They also know how to gain financial independence through that activity. The relatively low standard deviation of their assessment of saving motives' importance suggests the high compatibility of the respondents' opinions in that matter.

Although the analysed saving motives are considered essential in the respondents' assessment, their opinions do not translate into saving goals and other aspects of saving behaviour. Out of the list of 14 saving goals, only four were identified by more than 30% of the respondents, seven others were viewed by from 10% to 20% of the households representatives and the last four were chosen by less than 10%. These figures clearly suggest that the knowledge and opinions of the importance of saving are not supported by real activity. This statement is strengthened by the data representing behaviour of the respondents in terms of saving, which clearly reflect that Polish households save mostly occasionally and without employing any strategy such as using adequate financial instruments.

The results indicate a rather disturbing picture of Polish households' saving behaviour. Despite the fact that the Polish financial market is highly developed, to the level that recently analysts stopped considering Poland an emerging market, Polish households do not take full advantage of that fact. Many households store their saving in liquid instruments or in cash even if their goal of saving is long term. The lack of translating saving motives into actual saving behaviour can be influenced by many, not just economic, factors because households are under social and cultural constraints. Nevertheless, both financial and educational institutions should intensify their efforts in educating individuals to adjust their offers of financial instruments to the needs of households.

References

- Browning, M., Lusardi A. (1996). Household Saving: Micro Theories and Micro Facts. *Journal of Economic Literature*, vol. XXXIV(December), pp. 1797–1855.
- Canova, L., Maria, A., Rattazzi, M., Webley, P., Rattazzi, A. M. M., Webley, P. (2003). The hierarchical structure of saving motives. *Journal of Economic Psychology*. DOI: <http://doi.org/10.1016/j.joep.2003.08.007>.
- Devaney, S. A., Anong, S. T., Whirl, S. E. (2007). Household Savings Motives. *Journal of Consumer Affairs*, vol. 41(1), pp. 174–186. DOI: <http://doi.org/10.1111/j.1745-6606.2006.00073.x>.
- Fisher, P., Anong, S. (2012). Relationship of Saving Motives to Saving Habits. *Journal of Financial Counseling and Planning*, vol. 23(1), pp. 63–79. Retrieved from: https://www.afcpe.org/assets/pdf/v23_j4.pdf.
- Lindqvist, A. (1981). A note on determinants of household saving behavior. *Journal of Economic Psychology*, vol. 1(1), pp. 39–57. DOI: <http://doi.org/10.1016/0167->

4870(81)90004-0.

Schunk, D. (2009). What Determines Household Saving Behavior? An Examination of Saving Motives and Saving Decisions. *Jahrbücher Für Nationalökonomie Und Statistik/Journal of Economics and Statistics Bd*, vol. 229(2294), pp. 467–491. Retrieved from: <http://www.jstor.org/stable/23813451>.

Xiao, J. J., Noring, F. E. (1994). Perceived Saving Motives and Hierarchical Financial Needs. *Financial Counseling and Planning*, vol. 5, pp. 25–45.

Yao, R., Wang, F., Weagley, R. O., Liao, L. (2011). Household Saving Motives: Comparing American and Chinese Consumers. *Family and Consumer Sciences Research Journal*, vol. 40(1), pp. 28–44. DOI: <http://doi.org/10.1111/j.1552-3934.2011.02086.x>.

The Relationship between Saving and Debt in Polish Households

Anna Magdalena Korzeniowska¹, Wojciech Misterek²

¹ Maria Curie-Skłodowska University in Lublin
Faculty of Economics, Department of Banking
Pl.Marii Curie-Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: anna.korzeniowska@umcs.lublin.pl

² Maria Curie-Skłodowska University in Lublin
Faculty of Economics, Department of Banking
Pl.Marii Curie-Skłodowskiej 5, 20-031 Lublin, Poland
E-mail: wojciech.misterek@umcs.lublin.pl

Abstract: *It can be assumed that having saving and credit is mutually incompatible, because the logics requires paying down of any debt if one has financial surpluses. This is because the cost of servicing debt is much higher than the benefits of interest on saving. As the observation of real household behaviour proves the opposite, the aim of this paper is to analyse the relationship between saving and debt of households, which is illustrated by the case of citizens of Lubelskie Voivodeship (Poland). The research conducted on a group of 223 working representatives of households shows that more than 50% of persons with bank loans also have saving that exceeds in its amount a 3-month income of a respondent. It is worth noting, however, that among persons assessing their financial situation as good or very good, the percentage of such persons is higher than in the case of people assessing their financial situation as bad or rather bad. In the latter group, many more people are holding only credit products. The research has also shown that people with saving are more likely to use car loans and credit cards, while people who do not save are more likely to use cash credits and cash loans. In both groups, the percentage of people with mortgages is comparable.*

Keywords: *personal finance, credit instruments, saving level*

JEL codes: *D14, G21*

1 Introduction

Consumption spending is the most important component in the expenditure method of calculating the gross domestic product. Therefore, the number of research topics connected with consumption is not surprising. Scientists research the level of consumption expenditure as part of national demand, the structure of the consumption on a micro level and sources of financing consumption. The standard theory claims that the level of consumption depends on a disposable income because the basic decision of the household is how to divide the income into consumption and savings when the latter is understood as postponing consumption. From this perspective, households' debt is treated as accelerating consumption in time that in consequence will be paid off during coming periods by using saving. The intertemporal aspect of saving is fundamental for understanding households' financial behaviour (Börsch-Supan and Essig, 2003).

The commonly shared approach in the analysis of the household's wealth (which is co-integrated with income and consumption ((Dreger and Reimers, 2011)) on a micro level is to focus on net wealth, whereby the household's liabilities are deducted from its assets (Kukk, 2014). But while drawing proper conclusions, there is a problem with heterogeneity of household assets across countries because there are noticeable differences in real estate ownership, which is an important part of real assets. Another problem is that the same net wealth can be calculated from various combinations of assets and liabilities. That is why in another approach, researchers compare only financial assets with liabilities. It is claimed that households use credit to smooth their income, but the process is affected by credit constraints. There is also a relationship between credit constraints and selection of financial assets (Wang, 2016).

Scientists are also interested in households with income that is lower than their expenditures. The question arises how households deal with these expenses. Usually the sources of financing over-expenditure are wealth/past saving, formal credits and loans, informal loans in the form of assistance from family and/or friends and unpaid bills (Le Blanc, Porpiglia, Teppa, Zhu, and Ziegelmeyer, 2015). This prompts to further analysis on the financial situation of vulnerable households (Ampudia, van Vlokhoven, and Żochowski, 2016).

There is little to none simultaneous research on both saving and debt of households. Usually debt is used only as a background for saving opportunities of individuals or it is treated as a constraint to save, especially if we take into consideration the debt-to-income ratio of households, which in the European Union is much higher than 100% (Rocher and Stierle, 2015).

It can be assumed that having saving and credit mutually exclude each other, because the logics require paying down of any debt only if financial surpluses are generated. This is because the cost of servicing debt is much higher than the benefits of interest on saving. However, the observation of real household behaviour proves the opposite. This is particularly the case with the precautionary and the life-cycle motives of saving. For example, according to the Polish Central Bank, the value of financial assets of households at the end of the 1st quarter of 2017 was 1 953,7 bln PLN, while at the same time, the value of financial debt was 701 bln PLN (Kolasa, 2017). Therefore, this paper analyses the relationship between saving and debt of households in Lubelskie Voivodeship (Poland).

2 Description of the methodology and the research sample

This paper researches financial aspects of households' functioning in Lubelskie Voivodeship. The research was run by the scientists from the Faculty of Economics of Maria Curie-Skłodowska University in Lublin under the patronage of the research staff of the Department of Banking. The research was carried out with the use of the direct questionnaire survey methodology. The questionnaire was completed by 223 professionally active persons representing households. Among the respondents, the majority had employment contracts or some other similar form of employment, and they account for 79.37% of the research sample. A significant proportion of the respondents run their own businesses (12.11%) or farms. The remaining respondents (1.35%) most often combined a few forms of employment. Although the questions referred to the financial standing of the whole household, the structure of the respondents affected the answers only to a small extent. The research group was dominated by women (56.95%) and persons aged 36-45 (30.49%). There were slightly fewer persons aged 26-35 (26.46%) and 46-55 (21.52%). The least numerous were respondents up to the age of 25 (13.01%) and those 56 and older (8.52%). The research was carried out in Lubelskie Voivodeship, which is the sample included 30% of households in towns with more than 200 000 inhabitants and villages, 20% in towns up to 20 000 inhabitants as well as between 20 000 and 200 000 inhabitants. The research covered households of various sizes. A similar proportion, i.e. at the level of 27%, was recorded for two-, three-, and four-person households. Slightly over 12% of the research group were households consisting of a minimum of five persons, and only 6.3% were single person households.

To sum up, the structure of the research sample fully reflects the structure of the inhabitants of the examined region both in terms of demographic and social factors.

3 Comparative analysis of holding saving and credit

With the right assumption, saving and credit are mutually exclusive because the logics require repaying debt when some financial surpluses are generated. It results from the fact that the cost of debt service is much higher than benefits from interest rates for savings.

However, the research shows that over 30% of persons with bank credits hold saving that exceeds a three-month income of a respondent. If the research was to take into account also those persons with saving lower than a three-month income, it would appear that a group of respondents with both credits and saving increases to more than 50%. Therefore, it seems appropriate to verify the characteristics of this group of persons and the nature of the debt they hold.

Analysis of the data in Table 1 shows that a financial standing is essential for holding debt or saving instruments. It is clear that the higher assessment of a household's financial standing, the higher the number is of individuals holding saving or credit together with saving. Within the group, which is of key importance for the research, i.e. those persons who hold both credit and saving, 40% assess their financial standing of their households at a good or very good level, and only 6% said their situation is bad or very bad. This structure is very similar to the structure of persons holding only saving. For comparison, among persons with credits only, only 20% of persons assess the financial situation of their households at a good or very good level, and nearly 30% of those declared it is bad or rather bad.

Table 1 Structure of Respondents by Their Individual Assessment of a Household's Financial Standing

Financial standing	Only credit	Only saving	Credit and saving	Neither credit nor saving
Bad	6.7% (1.6%)	1.2% (0.0%)	0.0% (0.0%)	0.0% (3.0%)
Rather bad	20.0% (9.4%)	3.7% (1.7%)	6.0% (5.9%)	10.0% (9.1%)
Average	53.3% (56.3%)	43.2% (41.4%)	53.0% (50.0%)	70.0% (54.5%)
Good	20.0% (29.7%)	40.7% (43.1%)	34.2% (35.3%)	20.0% (30.3%)
Very good	0.0% (3.1%)	11.1% (13.8%)	6.8% (8.8%)	0.0% (3.0%)

* the data in parenthesis are given for the assumption that saving must account for minimum three-month incomes of a household

Source: Own study based on questionnaire surveys

Giving the assumption that saving should account for minimum three-month incomes of a household (the data in parentheses in Table 1), the reliances indicated are also confirmed. Yet, the discrepancies between the answers from persons only with credits and possessors of credits and saving or only savings are slightly smaller.

The data presented in Table 2 identify a similar reliance between a saving instrument and/or credit and income per capita in the household. It becomes evident that the respondents holding both credit and saving and those with saving only are wealthier than the respondents who have only credit. In the first two groups, the proportion of persons with incomes higher than 2400 PLN per person is between 21.7-28.6%, and those earning the least (less than 1 600PLN per person) account for 40%, while among the persons with credit only, the proportions are -12.7% and 54.5%, respectively.

Therefore, while the financial standing of a household has an effect on saving, it has no effect on debt. The data in Fig. 1 shows that the level of saving does not affect holding or not holding credit. It is clear that for all the groups of respondents with different levels of saving, the proportion of persons declaring bank debt is similar, and its level is 46.9%-

67.5%. What is also essential is the fact that it is difficult to identify any trend here, whether it is an uptrend or downtrend.

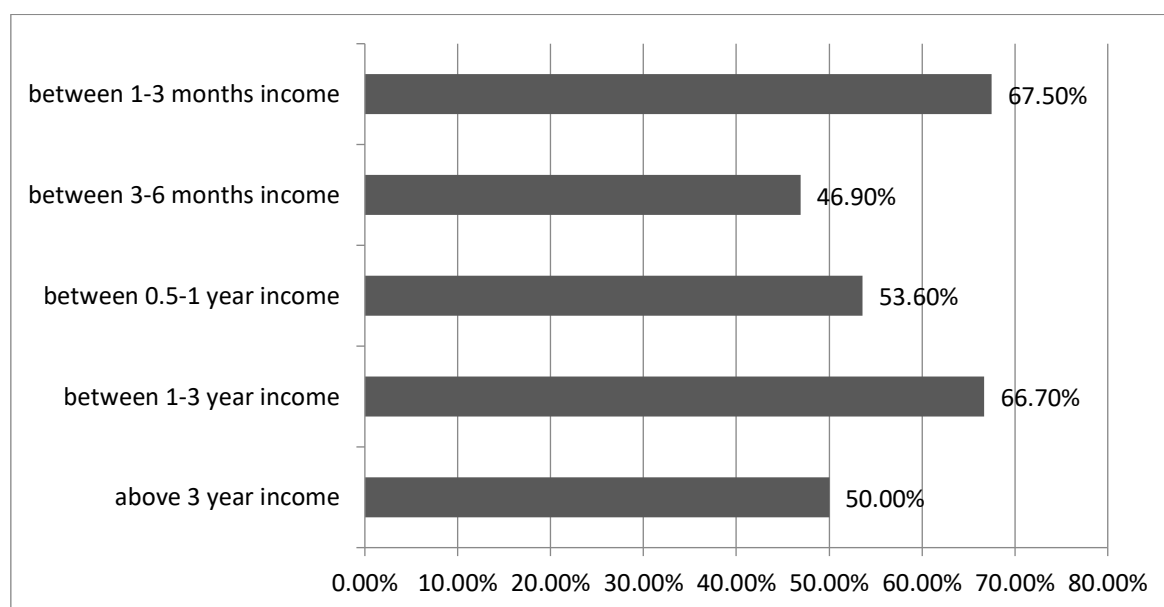
Table 2 Structure of Respondents with Credit or Saving by Income per Capita in a Household (for the analysis, it was assumed that saving must account for minimum three-month incomes of a household)

Income per capita in a household (in PLN)	Only credit	Only saving	Credit and saving	Neither credit nor saving
0-799	10.9%	2.0%	6.7%	8.0%
800-1599	43.6%	38.8%	33.3%	52.0%
1600-2399	32.7%	30.6%	38.3%	36.0%
2400-3199	10.9%	18.4%	10.0%	0.0%
> 3199	1.8%	10.2%	11.7%	4.0%

* the data in parenthesis are given for the assumption that saving must account for minimum three-month incomes of a household

Source: Own study based on questionnaire surveys

Figure 1 Percentage of Persons Holding Credits with Different Levels of Household Saving



Source: Own study based on questionnaire surveys

Hence, if the income (wealth) of a household is a determinant of saving but not credit, it is worth verifying what affects decisions to use credit. It is then fairly justified to compare types of credit typical for the groups of respondents with different levels of saving. It should allow diagnosing why persons holding saving hold credit at the same time. As the data from Table 3 show, the amount of saving influences a particular type of credit. These dependencies, however, may vary because for some types of credit, an increase in saving causes this very type of credit to be more common, while for others, an increase in saving results in a decrease of the percentage of persons holding this type of credit.

The first group, for instance, has credit cards that are used by only several per cent of households with no saving or with saving equivalent to an annual income at maximum; more than 25% of households hold saving in excess of their annual income. This is clearly determined by a type of credit. People mostly use credit cards for convenience to temporarily improve their creditworthiness and to transfer debt service burden to another period. Consequently, economic rationality, which says that the cost of credit is higher than the interest rates on saving, is of minor importance. What is more, the cost of debt service in this case is low. That is why so many persons despite having some funds in their bank accounts decide to use a credit card to increase their comfort while clearing transactions.

Similarly, it applies to car credits. In this case, only a few households with no or a low level saving use this form of debt. Yet, among individuals with saving higher than their annual income, the frequency of this type of debt is higher and ranges from several to several dozen per cent. Also in this case, the purpose of the credit affects the situation. Car credit is often used by persons only because they would like to split the burden of purchase of a given means of transport over time, not because they are not able to set aside sufficient resources for a one-off transaction. Additionally, not less important is the influence of car manufacturers themselves, which encourage buy new vehicles by offering very cheap credits. Thus, wealthy persons, despite having saving, decide to purchase a new car by instalments and take advantage of car credit. This type of debt is less popular with less wealthy persons and therefore holding less saving may mostly result from the fact that such persons decide to buy second-hand cars for which car manufacturer offer no cheap credits.

Table 3 Percentage of Households with Different Levels of Saving and Holding Particular Types of Credit

Level of saving in monthly income of a household	No saving	Between 1-3 months income	Between 3-6 months income	Between 6-12 months income	Between 12-36 months income
Credit type					
Mortgage	24.0%	27.5%	18.8%	32.1%	27.8%
Credit card	16.0%	17.5%	6.3%	14.3%	27.8%
Credit line, e.g. in savings and transaction account	8.0%	3.8%	6.3%	0.0%	0.0%
Car credit	0.0%	8.8%	3.1%	7.1%	11.1%
Credit/Cash loan	20.0%	15.0%	15.6%	3.6%	11.1%
Consumer credit	4.0%	10.0%	6.3%	3.6%	11.1%
Student credit	4.0%	1.3%	3.1%	0.0%	0.0%
Consolidation loan	0.0%	1.3%	0.0%	0.0%	5.6%

Source: Own study based on questionnaire surveys

A reverse situation is the case of cash credit/loan. This form of funding is more commonly used by households with low saving, i.e. less wealthy ones, because it is a form of debt

used mainly to replenish current cash flow shortages when there is no other way to provide funds. Although these credits are very expensive, there are persons who decide to choose them because they have no other alternative and also because interest rates on their saving are lower than the cost of the debt.

Student credit is relatively commonly used by households with low saving. However, age is a decisive factor in this case. Young persons who use this form of credit to finance their education are obliged to repay it in the first years of their employment. Consequently, such debt is still serviced even though some surpluses in saving are systematically generated.

It is worth noting that in the case of some credits, the frequency of their use is comparable for persons both with high and low saving. This is the case for mortgages, which are used to split very high payments into a few or a few dozen years. Rare is the case when saving allows paying such a high debt off in one payment. As a result, this form of debt is chosen both by wealthy persons with high saving and those with lower income and saving. It would seem reasonable to repay this debt from saving, but persons with higher income and saving do not do this because they want more comfort of functioning and safety (so-called precautionary saving). The same applies to a credit line in the current account, except that it is affected not by the amount of debt but by its form. This credit is used while using a bank account, which is why so many persons take this opportunity, no matter how high their incomes and saving are.

4 Conclusions

It is natural to assume that holding saving and credit is mutually excluded because logically, one is expected to repay debt when financial surpluses are generated. As the research shows, it does not always hold true because more than 30% of persons with bank credit are able to hold saving that exceeds their three-months income, and another 20% hold some lower saving despite holding debt. This mainly results from the fact that financial standing of a household is a determinant of saving but not credit. Consequently, the higher the income generated by a household, the higher its saving is. It does not mean, however, that such a household has lower debt. This is influenced by the purpose for which credit is taken because many types of credit are offered for our convenience. Although we bear the costs of its service, we try to take advantage of it because it makes our functioning in the market much easier. We often decide to take credit despite holding saving because of an attractive commercial offer, e.g. car credit. Still, some other reasons are for mortgages, which allows a high one-off payment to be split over time. Although we are sometimes able to generate surpluses, we decide to put aside some saving rather than make an early payment of credit. These are psychological factors that decide that our priority is to hold free financial resources for safety, not to reasonably repay debt.

References

- Ampudia, M., van Vlokhoven, H., Żochowski, D. (2016). Financial fragility of euro area households. *Journal of Financial Stability*, vol. 27(December 2016), pp. 250–262. DOI: <http://doi.org/10.1016/j.jfs.2016.02.003>.
- Börsch-Supan, A. (2000). International Comparison of Household Savings Behaviour: A Study of Life-Cycle Savings in Seven Countries. *Discussion Papers*. Retrieved from: <http://ideas.repec.org/p/mnh/vpaper/1016.html>.
- Börsch-Supan, A., Essig, L. (2003). Household Saving in Germany: Results of the first SAVE study. *NBER working paper*, no. 9902. Retrieved from: <http://www.nber.org/papers/w9902>.
- Dreger, C., Reimers, H.-E. (2011). The long run relationship between private consumption and wealth: common and idiosyncratic effects. *Portuguese Economic Journal*, vol. 11, pp. 21–34. DOI: <http://doi.org/10.1007/s10258-011-0075-y>.

- Kolasa, A. (2017). *Sytuacja finansowa sektora gospodarstw domowych w I kw. 2017 r.* Warszawa: Departament Analiz Ekonomicznych NBP, Nr 03/17.
- Kukk, M. (2014). Distinguishing the Components of Household Financial Wealth: the Impact of Liabilities on Assets in Euro Area Countries Merike Kukk. *Eesti Pank. Working Paper Series*, no. 2.
- Le Blanc, J., Porpiglia, A., Teppa, F., Zhu, J., Ziegelmeier, M. (2015). Working Paper Series Household saving behaviour and credit constraints in the euro area.
- Rocher, S., Stierle, M. (2015). *Household saving rates in the EU: Why do they differ so much?* No. 2015.01, Vol. 8022.
- Von Kalckreuth, U., Eisele, M., Le Blanc, J., Schmidt, T., Zhu, J. (2012). *The PHF: a comprehensive panel survey on household finances and wealth in Germany*. Retrieved from: <https://www.econstor.eu/bitstream/10419/59999/1/719704995.pdf>
- Wang, G. (2016). Credit Constraints and Household Selection of Financial Assets. *Open Journal of Social Sciences*, (February), pp. 47–56.

The Selected Aspects of Foreign Trade in Central European Countries

Jaroslav Kovárník¹, Eva Hamplová²

¹ University of Hradec Králové
Faculty of Informatics and Management, Department of Economics
Rokitanského 62, 500 03 Hradec Králové, Czech Republic
E-mail: jaroslav.kovarnik@uhk.cz

² University of Hradec Králové
Faculty of Informatics and Management, Department of Economics
Rokitanského 62, 500 03 Hradec Králové, Czech Republic
E-mail: eva.hamplova@uhk.cz

Abstract: *This article deals with the selected aspects of foreign trade development in the countries from central Europe, namely the Czech Republic, Poland, Slovakia, Hungary, where these countries belong into Visegrad Four, and Germany, because countries of V4 have usually strong connections with Germany. The article continues with analysis from other articles presented on other conferences, and it analyses development since 2000, and it focuses on selected aspects of foreign trade development, because foreign trade is crucial part for sustainable development for almost all countries around the world (it is part of GDP formula in open economy). The article analyses development of foreign trade with goods and with services, where have been discovered relatively surprising results (the weakest economy in terms of services has been Germany), but consequently the article analyses relations between export development, foreign trade development, and GDP development. In theoretical point of view, export is considered to be independent on domestic product, and economically weak countries are usually considered to be more dependent on export (in terms of GDP development). This fact has been proved during analysis, where especially V4 countries are strongly dependent on export. However, the final impact of net balance of foreign trade on GDP is relatively weak in all V4 countries, which is relatively surprising fact again. Detail description of results is in this article.*

Keywords: Central Europe, Czech Republic, export, foreign trade, import

JEL codes: F43, O11

1 Introduction

Foreign trade is very important for every state all around the world because it is, among others, part of macroeconomic Gross Domestic Product (GDP) formula. In other words, it can either improve the GDP level (in case that export is higher than import) or worsen it (in the opposite case). This basic theory has been explained in many books and articles, for example in Andrews, Bernake, & Croushore (2011), or Samuelson & Nordhaus (2010).

Nevertheless, foreign trade is important for every country because of other reasons as well. In almost all countries worldwide, foreign trade helps to solve the proportionality problem, where only few countries have all necessary resources in quantities required for economic development. Foreign trade also has demonstrative effect, where the export program is kind of indicator of the level of economic development, and it also helps create an image of developed country. Foreign trade has also other benefits, such as support of peaceful cooperation among partners, reducing of the risk of conflict, growth of education, and others.

From above mentioned text is clear that foreign trade is very important for every country. The importance of foreign trade has been evaluated in other articles by other authors, for example Baier, Bergstrand & Feng (2014), Cieslik, Bieganska & Sroda-Murawska (2016), Do, Levchenko & Raddatz (2016), Fracasso & Marzetti (2015), Giordano & Zollino (2016), Gladkov (2016), or Vannoorenberghe (2014). Authors themselves already analysed the

topic of foreign trade several times, for example in Kovárník & Hamplová (2016), or Kovárník & Hamplová (2017).

The Czech Republic is a member state of Visegrad Four, and all other member states (namely Poland, Slovakia, and Hungary) are very important business partners for the Czech Republic. Situation in Visegrad Four countries has been also analysed by other authors, for example by Zdražil & Kraftová (2012). However, the most important business partner for the Czech Republic is Germany, where this economy has a very important position as a business partner for all V4 countries.

The aim of this article is to analyse the selected aspects of foreign trade in above mentioned countries, namely in the Czech Republic, Poland, Hungary, Slovakia, and Germany. Firstly, this article analyses the development of GDP in selected countries, because of the importance of foreign trade for this indicator. The development of foreign trade in terms of goods and in terms of services in these countries is next topic for analysis. Consequently, the relation between export and GDP and between foreign trade and GDP are analysed as well. The aim is to verify the hypothesis whether the development of both GDP and foreign trade of these countries is similar or not, and also to verify whether especially small and relatively weak economies are more open and more dependent on foreign trade.

2 Methodology and Data

Covered period of time is 2000 – 2017, where data were obtained in general available database Eurostat and calculated by authors (Eurostat a, 2018, Eurostat b, 2018).

Methods of comparison and comparative analysis have been used. Moreover, for the verification of above mentioned hypothesis about openness of economy can be used several different calculations. One of the most frequently used calculations measures the relation between export and GDP, where more open economies usually have high ratio. Another possible calculation uses turnover of foreign trade (summary of both export and import) on GDP.

On the other hand, the importance of foreign trade for GDP creation can be evaluated by the size of net balance on GDP, because in the theoretical point of view, only net exports are part of GDP formula in open economy.

3 Results and Discussion

The Analysis of GDP Development

Based on the fact that the Czech Republic has currently around 10.5 billion of inhabitants, Hungary around 9.8 billion, Slovakia around 5.4 billion, Poland more almost 38 billion, and Germany more than 82 billion, it is quite obvious that the level of GDP in billions of euro is the highest in Germany, second highest in Poland, next in the Czech Republic, in Hungary, and Slovakia is on last position.

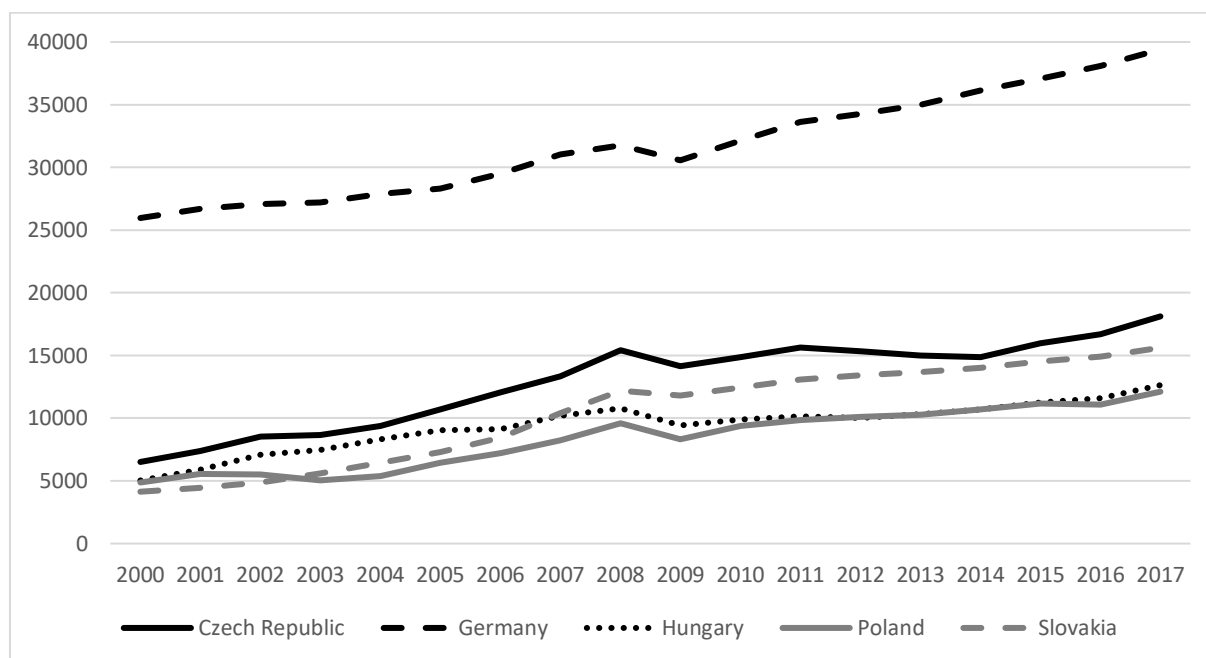
However, it is better to use the level of GDP per capita for comparison. According to this, Germany still has the highest level, but the Czech Republic is on the second position, Slovakia is the third, Hungary on the fourth place, and Poland is the last. With respect to this information is good to add one interesting fact. Even if the development in the number of inhabitants in each country have not been steady, this number grew in the all analysed countries except Hungary (comparison of the number of inhabitants in the years 2000 and 2017).

Deep analysis of GDP development shows that in all analysed countries was significant decrease in this indicator in the year 2009 (both in absolute value and in per capita) as a result of global economic crisis. However, the after crisis development is different. Germany has been growing since 2009 and it managed exceed pre-crisis year already in 2010. The Czech Republic was growing between 2009 – 2011, it was decreasing between 2011 – 2014, and it has been growing again since 2014. Moreover, it managed to exceed pre-crisis year in 2011, but the level of GDP per capita in this country decreased under the

pre-crisis year during the decrease, and it exceeded the pre-crisis level again in 2015. Poland was on the last position in 2008, it had been growing since 2009 to 2015, it dropped a little in 2016, and it has grown again in 2017. It exceeded pre-crisis year in 2011, and in the year 2012 (but only in this year) it exceeded Hungary. Hungary has been growing since 2009 with one exception in 2012. It was on the fourth position before crisis and it is on the fourth position again in 2017. Slovakia has been growing, as well as Germany, since 2009, and it also managed to exceed pre-crisis year within one year.

Following Fig. 1 shows the development of GDP per capita in analysed countries.

Figure 1 GDP Development (Euro per Capita)



Source: own calculations based on Eurostat a (2018), Eurostat b (2018)

Foreign Trade Development – Trade with Goods

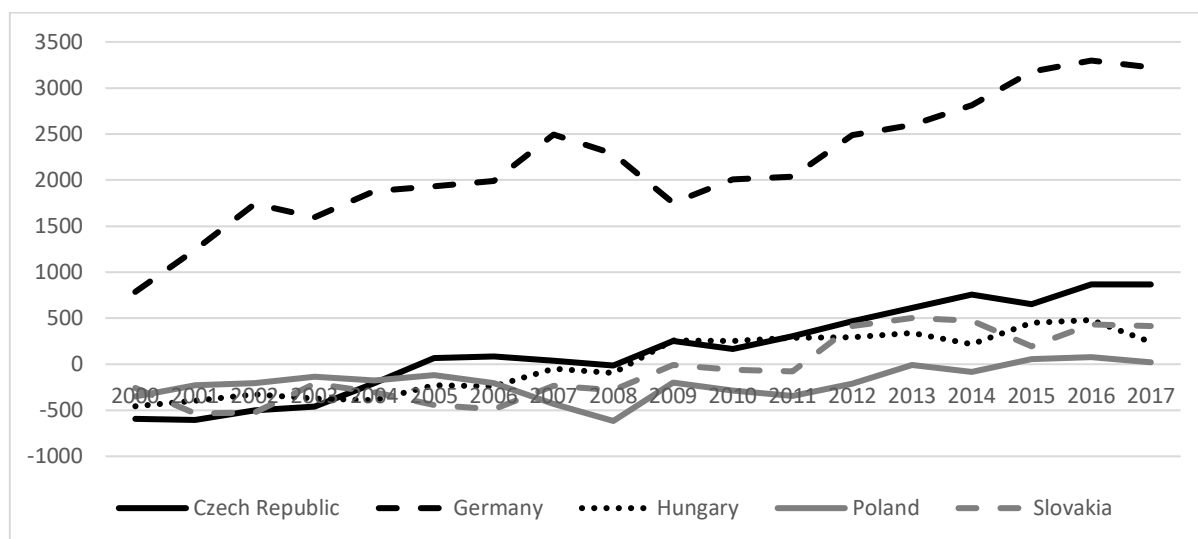
The analysis of foreign trade development shows relatively different results than the GDP development analysis. The development of net balance in terms of goods recalculated per capita is described in following Fig. 2. Recalculation per capita is necessary, because absolute values of net balance in Germany are significantly higher than in other countries and mutual comparison of all five countries in absolute values is difficult. After the recalculation, Germany is still on the first position, but the differences are lower.

First interesting fact is that in the first analysed year (2000) all countries except of Germany had negative trade balance, which means they had higher imports than exports. Even if current trade balance is positive in all analysed countries, the development has been quite irregular. Germany had surplus more than 64,000 billion in 2000, and it had surplus around 268,000 billion in 2017. The second highest surplus in 2017 had the Czech Republic, where this surplus is little bit more than 9,000 billion.

As was already mentioned, Germany has been in surplus and it has had the strongest position from all analysed countries. However, the mutual comparison of V4 countries shows interesting results. The Czech Republic had the worst position in 2000 (the highest deficit per capita, while in absolute amount had Poland worse result), but it has been growing (with few exceptions), and currently the Czech Republic has the second highest surplus (after Germany). Exactly opposite development has been in Slovakia. This country had the best result from V4 countries in 2000 (both in absolute amount and per capita), but it has the second worst result in 2017 in absolute amount and the third highest values in terms of net balance per capita (after Germany and the Czech Republic). Really interesting fact is that in 2009, during the economic crisis, was net balance decreasing in

Germany, while it was increasing in all other analysed countries. Moreover, the net balance grew in Germany in 2010, while it decreased in all analysed countries. The development of foreign trade with goods per capita is described in the following Fig. 2.

Figure 2 Foreign Trade with Goods (Euro per Capita)

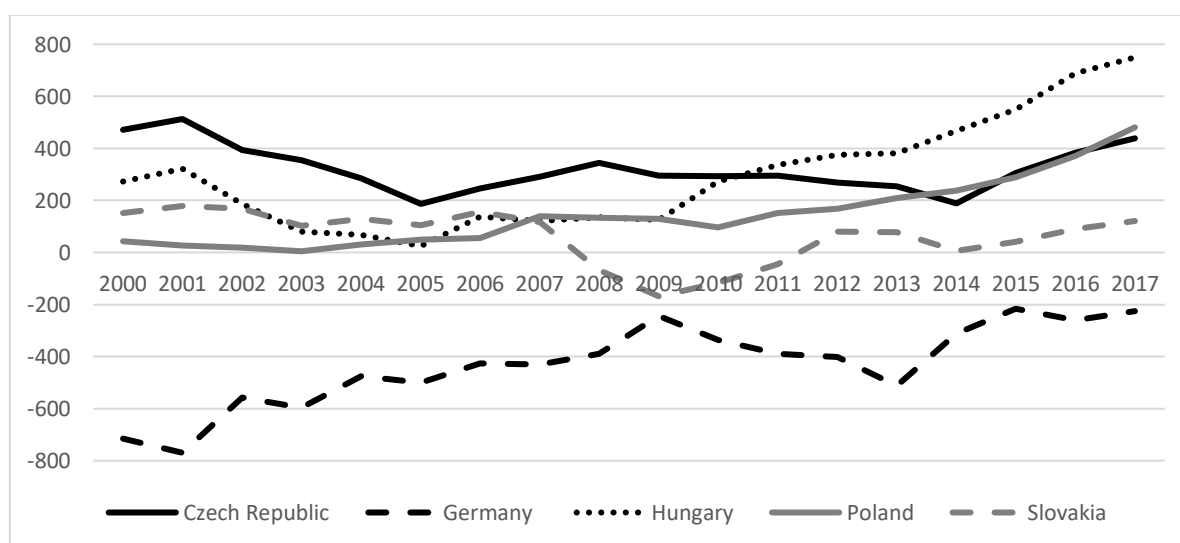


Source: own calculations based on Eurostat a (2018), Eurostat b (2018)

Foreign Trade Development – Trade with Services

The analysis of foreign trade with services shows completely different results. Surprisingly, the only country which has been in deficit for all analysed period is Germany. All other V4 countries has been in surplus, with only few exceptions in case of Slovakia. However, the development is quite irregular in all countries, with several increases and decreases. Nevertheless, the deficit in Germany in 2017 is lower than in 200, but on the other hand, surpluses in the Czech Republic and in Slovakia decreased, while surpluses in Poland and in Hungary increased. The development (again recalculated per capita) is described in Fig. 3.

Figure 3 Foreign Trade with Services (Euro per Capita)



Source: own calculations based on Eurostat a (2018), Eurostat b (2018)

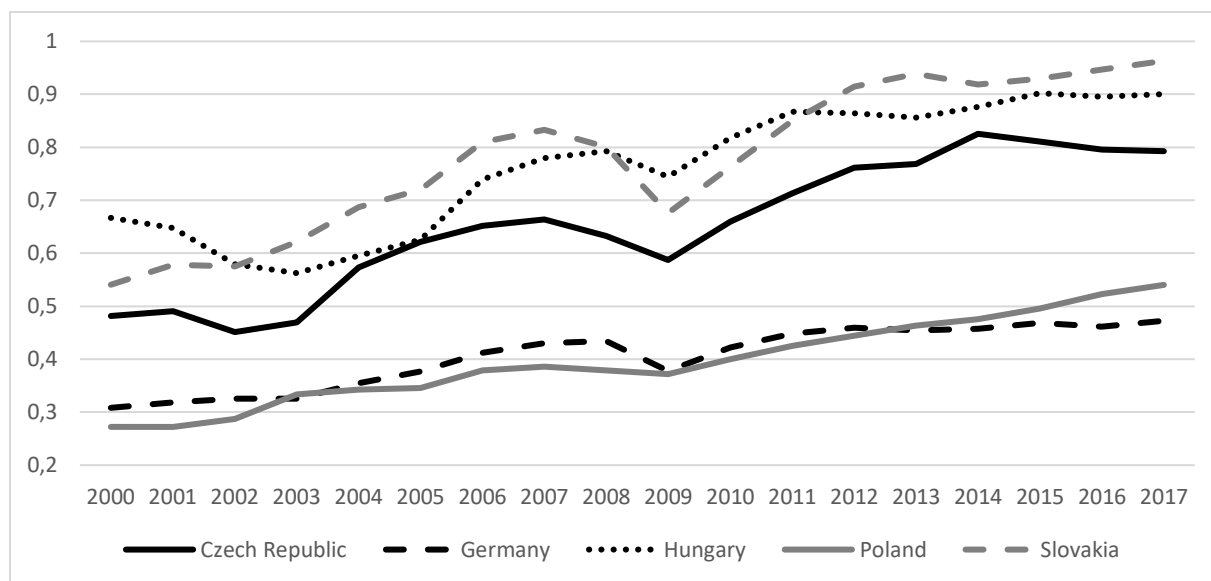
The Relation between Export and GDP Development

As was mentioned before, one of the aims of this article is to verify the openness of analysed countries, where one of the possible tools (indicators) for this evaluation is the

ratio between export and GDP. Open economies usually have high value of this ratio, where more closed economies have lower values. Openness is typical for small and developing economies, where more closed are usually large and developed economies.

The share of export on GDP (in percent) is described in following Fig. 4.

Figure 4 Export on GDP Ratio (%)



Source: own calculations based on Eurostat a (2018), Eurostat b (2018)

It is quite obvious that hypothesis about openness is verified. Despite the fact that Germany is not only the largest, but also the most powerful economy (in this article), its export on GDP ratio has been below 50% during the whole analysed period. This share is low also in Poland (in 2000, Poland had lower value than Germany, but in 2017, Poland had a little bit more than 50%), where this economy cannot be considered as powerful one (GDP per capita is the lowest, see Fig. 1), but it is large country (it has second highest number of inhabitants, and second highest value of GDP in absolute amounts).

All other analysed countries have had higher values. In 2000, the Czech Republic had this ratio under 50%, but it is around 80% nowadays. Hungary had this ratio more than 66% in 2000, but its development has not been steadily, and nowadays is Hungary on the second position with the export on GDP ratio around 90%. Slovakia had this ratio around 54% in 2000, but it has been growing relatively fast (compared to other countries), and this ratio is more than 96% in 2017.

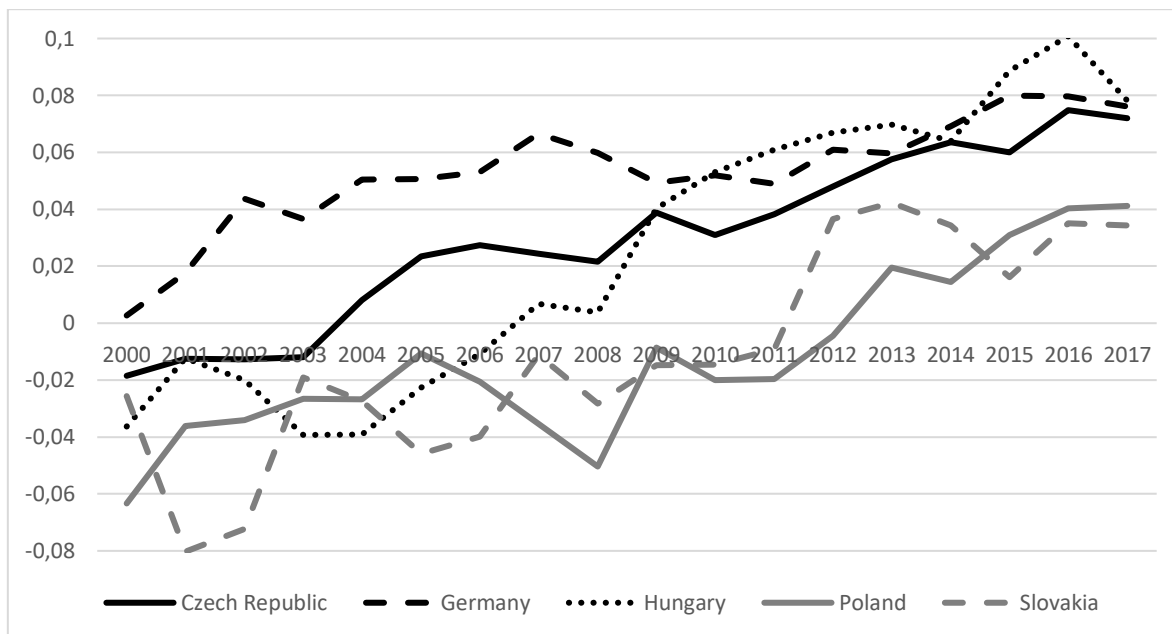
This can be explained in that way that small and weak economies are more dependent on foreign countries than large and / or more powerful economies. Of course, exceptions can exist, where powerful economies are dependent on foreign trade, or less powerful economies are not so dependent of foreign trade, even if they are relatively small. However, this is not an example of analysed countries. Less dependent seems to be Germany (powerful and large country) and Poland (not powerful, but large country with a lot of inhabitants), where the Czech Republic, Slovakia, and Hungary (relatively small and weak economies) seem to be more dependent on foreign trade.

Relation between Foreign Trade and GDP Development

Previous chapter analyses the openness of analysed economies with one of the possible tools, namely export on GDP ratio. The results have been not surprising, but this chapter is analysing the impact of foreign trade in national economy. In other words, in this chapter is the analysis of net balance of foreign trade on GDP. As was mentioned in previous text, in the formula of product in open economy can be found net exports, which can be calculated as a difference between exports and imports in particular economy in analysed year. The analysis in this chapter describes how many percent from GDP is presented by

net balance of foreign trade (net export). The results of this analysis are described in the following Fig. 5.

Figure 5 Net Balance of Foreign Trade on GDP Ratio (%)



Source: own calculations based on Eurostat a (2017), Eurostat b (2017)

It is quite obvious that all countries except Germany had been dealing with negative trade balance. That means that foreign trade was not helping generate the GDP, but it was worsening it. The Czech Republic turned into positive balance in 2004, Hungary in 2007, Slovakia in 2012, and Poland in 2013.

Analysis of each country can be done as follows. Germany is relatively closed economy (previous chapter), but despite of this fact, the foreign trade generates more than 7.6% of GDP. With respect to the fact that GDP in this country is significantly higher than in other analysed countries, net balance of foreign trade in Germany is also significantly bigger than in other countries. Even if Germany is not so dependent on foreign trade, it can generate a lot from it.

Even if Hungary turned into positive balance in 2007, it had the highest ratio in 2017 (almost 8%). Hungary had also the second highest export on GDP ratio. It can be explained in that way that Hungary is relatively open economy, where foreign trade is currently helping create the product in this country.

The third highest ratio has the Czech Republic (little bit more than 7%), where this country has had also the third highest export on GDP ratio. The explanation in this country can be same as in case of Hungary.

Poland is relatively closed economy (relatively low export on GDP ratio), and foreign trade in this country is not so much participating on creation of product, where it generates only little bit more than 4%. On the other hand, it is not so surprising result based on the fact that Poland is relatively closed economy.

As far as Slovakia is concerned, the results in this country are relatively surprising. Despite the fact that Slovakia has the highest export on GDP ratio (it is the most open economy), the foreign trade on GDP ratio is the lowest. Even if Slovakia is relatively dependent on foreign trade, it is not generating product in this country. In other words, Slovakia is exporting a lot, but it is also importing and the final impact of foreign trade on GDP is low.

4 Conclusions

The aim of this article was to analyse the selected aspects of foreign trade countries from central Europe, namely in the Czech Republic, Poland, Hungary, Slovakia, and Germany. Firstly, this article analyses the development of GDP in selected countries, secondly the development of foreign trade in terms of goods and in terms of services. Consequently, the relation between export and GDP and between foreign trade and GDP are analysed as well.

The analysis of GDP development shows relatively expected results. Germany is the strongest evaluated economy; it has the highest level of GDP not only in absolute value, but also in recalculation per capita. The second highest GDP in absolute value has Poland, because it is the second largest economy, where after recalculation per capita has the second highest GDP the Czech Republic, and Poland is the weakest.

In terms of trade with goods is Germany again the strongest economy, net balance has been in surplus in whole analysed period, and even after recalculation per capita has Germany serious lead. All other analysed countries have been dealing with deficit for some time, they are all in surplus now, but for example in case of Poland is this surplus really small. The second highest surplus is in the Czech Republic.

The analysis of trade with services shows relatively surprising results. All members of V4 have been in surplus for almost all period, where Germany has been in serious deficit for whole analysed period. However, the development is not steady at all, where the net balance in some countries grew (comparison between 2000 and 2017) and in other countries decreased.

The analysis of export on GDP ratio shows again relatively expected results about openness economy. Germany seems to be relatively closed economy, because it is strong and powerful country, and therefore it is not so dependent on foreign countries. Relatively closed economy seems to be also Poland, where this ratio is also low (around 50%). Poland is not developed country, but it is relatively large country with a lot of inhabitants. Small countries as the Czech Republic, Slovakia, and Hungary, seem to be relatively open economies with huge dependency on foreign trade.

However, the last analysis from this article shows again a little bit surprising results. Even if Germany is relatively closed economy, the share of net balance on foreign trade on GDP is relatively high in this country (more than 7%). High share can be seen also in the Czech Republic and in Hungary, where these countries are relatively open. However, Poland has relatively low share, but it is relatively closed economy. On the other hand, Slovakia has also low share despite the fact that it is relatively open economy.

To sum it up, foreign trade is very complex issue; it has a lot of aspects and factors of influence. It can be seen in this article, where sometimes the results are relatively surprising, strong economy has low dependency on foreign trade, but it still has a relatively huge influence on GDP, where in relatively open economy has the foreign trade only low impact on GDP. The authors plan to analyse foreign trade from different perspectives in following research.

Acknowledgments

This study is supported by internal research project "Investment within concept Industry 4.0", and by project IGA 2018 "Support of pedagogical work, technical equipment, and communication with experts", both at Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic. It was prepared in cooperation with students of Ph.D. study at Department of Economics, namely with Ing. Vojtěch Tuček and Ing. Martin Král.

References

Andrews, A. B., Bernake, B., Croushore, D. D., (2011). *Macroeconomics*, 6th ed. Boston: Addison-Wesley.

Baier, S. L., Bergstrand, J. H., Feng, M. (2014). Economic integration agreements and the margins of international trade. *Journal of International Economics*, vol. 93(2), pp. 339-350.

Cieslik, E., Bieganska, J., Sroda-Murawska, S. (2016). The Intensification of Foreign Trade in Post-Socialist Countries and Their Role in Global Value Chain. *Acta Oeconomica*, vol. 66(3), pp. 465-487.

Do, Q. T., Levchenko, A. A., Raddatz, C. (2016). Comparative advantage, international trade, and fertility. *Journal of Development Economics*, vol. 119(1), pp. 148-166.

Eurostat a (2018). *International Trade of EU, the Euro Area and the Member States by SITC Product Group*. Retrieved from: <http://ec.europa.eu/eurostat/web/international-trade/data/database>.

Eurostat b (2018). *GDP and Main Components*. Retrieved from: <http://ec.europa.eu/eurostat/web/national-accounts/data/database>.

Fracasso, A., Marzetti, G. V. (2015). International trade and R&D spill overs. *Journal of International Economics*, vol. 96(1), pp. 138-149.

Giordano, C., Zollino, F. (2016). Shedding Light on Price- and Non-price-competitiveness Determinants of Foreign Trade in the Four Largest Euro-area Countries. *Review of International Economics*, vol. 24(3), pp. 604-634.

Gladkov, I. S. (2016). European Union in Modern International Trade. *Contemporary Europe-Sovremennaya Evropa*, vol. 1(1), pp. 85-94.

Kovárník, J., Hamplová, E. (2016). The Analysis of Foreign Trade Development in the Countries of Visegrad Four. In: Klímová, V., Žítek, V., eds., *19th International Colloquium on Regional Sciences*. Brno: Masaryk University, pp. 240-246.

Kovárník, J., Hamplová, E. (2017). The Brief Analysis of Foreign Trade of the Czech Republic in International Comparison. In Nešleha, J., Plíhal, T., Urbanovský, K., eds., *Proceedings of the 14th International Scientific Conference European Financial Systems 2017*. Brno: Masaryk University, pp. 384-393.

Samuelson, P. A., Nordhaus, W. D. (2010). *Economics*, 19th ed. Boston: McGraw-Hill/Irwin.

Vannoorenberghe, G. (2014). International trade, risk taking and welfare. *Journal of International Economics*, vol. 92(2), pp. 363-374.

Zdražil, P., Kraftová, I. (2012). Konvergují regiony zemí V4? In: Klímová, V., Žítek, V., eds., *15th International Colloquium on Regional Sciences*. Brno: Masaryk University, pp. 48-58.

Labour Taxation in the European Union. Comparative Analysis and Conclusions for Poland

Anna Krajewska, Magdalena Kapela

Warsaw University of Technology
College of Economics and Social Sciences
Łukasiewicza 17, 09-400 Płock, Poland
E-mail: Anna.Krajewskal@pw.edu.pl
E-mail: Magdalena.Kapela@pw.edu.pl

Abstract: *Labour tax burdens consist of two main elements: personal income tax and social security contribution. Both have been subjects of multiple changes in European Union countries. The aim of the article is: 1) to present main directions of those changes, 2) to show their influence on tax wedge in different EU countries, 3) to show specification of labour taxation in Poland. Tax wedge in Poland demonstrates very low progressivity, that means it does not take into consideration income and family situation. Internal structure of tax wedge is also untypical because of great share of social security contribution. In the article there has been undertake an attempt to present causes of tax wedge otherness in Poland and resulting economic and social fallouts. Also, there are postulated directions of changes. In the paper analysis were based on Eurostat and OECD statistics and research on labour taxation carried out in Poland.*

Keywords: *labour taxation, personal income tax, social security contribution, tax wedge, redistribution of income*

JEL codes: *E62, E64, H20, H21, J08*

1 Introduction

The aim of the paper is to present main directions of labour taxation in European Union. We also intend to explain specific features of labour taxation in Poland.

The stress is put on the following issues:

- Evolution of labour taxation in selected EU countries,
- Redistributive aspects of tax wedge,
- Internal structure of tax wedge.

In conclusion we try to suggest directions of changes in taxation of labour in Poland.

2 Evolution of labour taxation

The basic foundations of the modern labour taxation system in the countries of Western Europe were formed after World War II and although in the following decades they underwent numerous modifications, the characteristic features of this system still persist.

Among the main features of personal income tax in Western European countries (Krajewska 2012, 88-97) should be mentioned:

- 1) The progressive nature of the tax reflected by the number of tax thresholds (currently from 2 in Ireland to 17 in Luxembourg) and the level of the lower (in the past, in the 1970s, amounted even 3-5-10%, but now slightly higher) and upper tax rates (currently mostly within 40-50%, in Sweden 57.1% (Taxation Trends.. 2017, p. 30)
- 2) The existence of the tax-free income, which is the result of a social consensus and which takes into account the level of income defined as the subsistence minimum, as well as civilization, cultural factors and social welfare. This amount changes along with the change in income, prices, costs of living, state of the economy.
- 3) The tax system indexation, automatic or steplike, consisting in adjusting the tax burden to the changing costs of living, and thus an increase in the amount of tax-free income and the amount of tax reliefs, raising the amount of income within the existing tax scale;
- 4) The existence of tax reliefs taking into account the family situation of taxpayers (such as for example the possibility of joint taxation of spouses' income, number of children,

their age and state of health, as well as the age and state of health of the taxpayer) or related to the method of disbursement of income (investment, construction, education reliefs and donations).

The aforementioned elements of tax structures were an important tool for the redistribution of income, especially in the post-war period of 30 years (the 50s, 60s, 70s of the 20th century). Taxes back then were very high (as the current criteria), and the scope of reliefs was extensive (Krajewska 2012:94-96). However, at the same time, the economies of Western Europe then were developing dynamically. Economic historians with fondness recall these "golden thirty years". Tax reforms carried out under the slogan of tax reduction and simplification as well as reduction of tax reliefs began in the 1980s along with the dissemination of neoliberal trends. In practice, however, it turned out that the process was relatively slow. The redistribution of income through progression, tax allowance and reliefs, although perhaps to a lesser extent, continued. The financial and economic crisis that started in 2008 not only stopped this process, but also caused that the tax stimulus and stabilizing function began to be noticed.

The anti-crisis packages included activities such as:

- raising the amount of tax allowance amount,
- reducing the lower PIT rate,
- implementation of a new (additional) upper PIT rate (it is worth recalling that under the presidential campaign in France, Francois Hollande proposed raising the upper PIT rate up to 75%),
- introduction of new reliefs or their raise,
- tightening the tax system.

All transforming countries in Central and Eastern Europe had to carry out thorough tax reforms. They had to face the following choice: to imitate solutions adopted in Western European countries (i.e. tax progression, tax allowance, tax reliefs) or to adopt their own solutions based on simple flat taxes. In the initial period of transformation, the countries of the Visegrád Group and Slovenia adopted solutions similar to the Western tax systems, and the Baltic countries adopted a flat tax. However, in a quick time, the flat tax spread in the countries of Eastern Europe. In Poland such attempts were made, but finally the tax scale was reduced from 3 to 2 rates (18% and 32%). Slovenia was the only country in which switching from progression to a flat tax was not considered. Progressive PIT also occurs in Croatia.

The second component of the tax wedge are social security contributions. European Union countries have not yet developed such a consistent system as in the case of income taxation. Differences between countries are very large.

The amount of social security contributions depends on public programs offering social security for citizens, financed from these sources, as well as on the age structure of the society. The increase in the level of benefits observed in economically developed countries, accompanied by the aging of the society, means that the tax burdens is growing. For example, in Sweden until the mid-1960s, the social security contribution was 7% of gross wages, in 1986 it increased to 36% so almost five times (Andersson, Norman, 1987, p. 144) and showed an upward trend in the following years – up to 38.4% in 2010 (European Commission... 2012, s. 159).

It is worth noting that relatively recently, social security contributions were not collected in Denmark, Finland and Australia. An even now, those contributions constitute only a few percent of the tax burden imposed on labour. Still an exception – a country, where there are no mandatory insurance premiums is New Zealand. This means that funds financed for retirement and disability pensions payments come from income taxes, which in these countries are therefore high.

Social security contributions burden employees and employers. The classic system that evenly burdens the employees and employers with contributions ("fifty-fifty" or in similar proportions) has now been preserved only in a few countries: in Germany, Switzerland, Luxembourg, the USA, Turkey, Korea, and also in Poland (OECD, 2013). The distribution

of the burden of employees and employers with contributions was subject to changes depending on the bargaining position and the power of both parties. During the 30 years after the war, strong trade unions were trying to transfer the burden of contributions more and more to employers. However, with the strengthening of the neo-liberal ideology, the position of employers grew, which in turn favoured transferring the burden of insurance contributions on employees. However, this process was quite slow. The global crisis, which began in 2008 and the increase in unemployment, especially among young people, caused that in many countries social security contributions, especially for young and unqualified employees, showed a declining trend.

In empirical research on the tax wedge, the most attention is paid to its height and impact on the labour market. Most often the conclusion that is drawn is that a high tax wedge reduces the demand for labour and leads to an increase in unemployment (Dolenec, Laporsek 2010, pp. 356-357; Góra et al. 2006; Tvrdon 2011; Wojciechowski 2008). Hence the conclusion is that the tax wedge should be lowered because it will allow to reduce unemployment. The research shows that the negative effects of the tax wedge affect the unqualified and low-paid employees the most, because their remunerations are less flexible than the ones of employees with high earners. Thus, a high tax wedge may slightly affect the employment decline of highly qualified employees, while it creates high unemployment among low-qualified employees. Thus, the macroeconomic consequences of the tax wedge depend on the qualification structure of employees. They are stronger in countries with a large share of low-qualified employees and lower in those where their share is low (Góra et al., 2006).

3 Tax wedge redistributive aspects in EU countries

In the Eurostat and OECD statistics, the tax wedge is defined as a percentage ratio of taxes imposed on labour to the total labour costs borne by the employer. The numerator of this fraction therefore includes the following elements: Income tax of natural persons performing a paid work, social security contributions paid by the employer, social security contributions paid by the employee and other taxes related to the employment of the employee. In turn, labour costs are: gross wages (net wages + personal income tax + contributions paid by employees), contributions covered by the employer and other taxes related to employment (OECD, 2014).

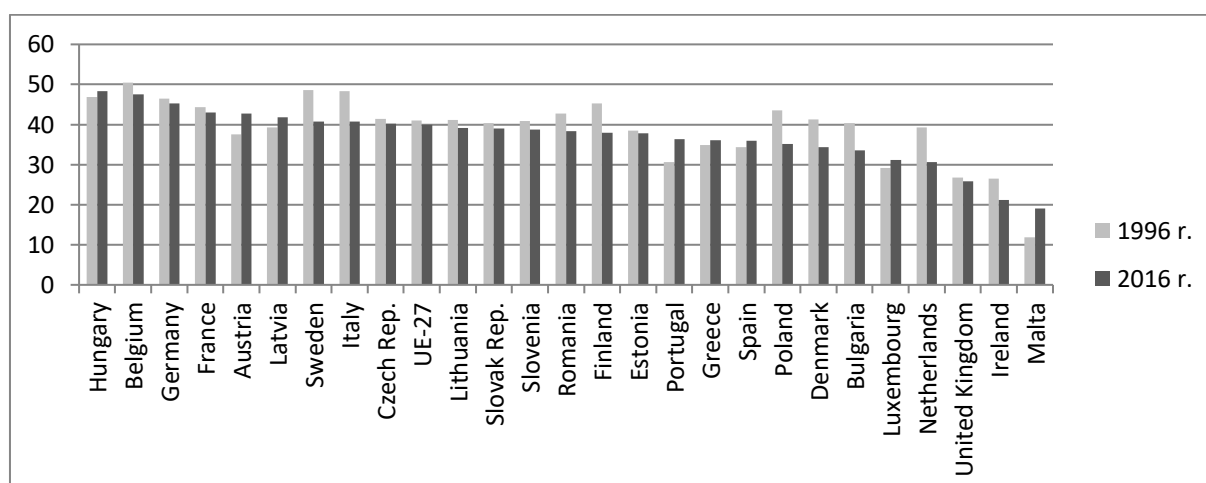
The tax wedge can be presented in the form of the following formula:

$$\text{Tax wedge} = \frac{\text{taxes imposed on labour}}{\text{labour costs}} \cdot 100\% \quad (1)$$

Tax burdens imposed on employees depend to a large extent on the amount of their earnings and the family situation (number of children, working or non-working spouses). For this reason, for the analysis of the tax wedge level, the most common are single, childless persons earning 67% of the average remuneration. This level of remuneration is treated as the median of average remuneration due to the concentration of high earnings in the upper deciles. In turn, the median is the basis for determining the remuneration defined as *low pay earners*. In the OECD and Eurostat statistics, it is assumed that remunerations defined as low are less than 2/3 of the remuneration median for the economy.

Over the past 20 years, the tax burden of low-paid work fluctuated (Figure 1). In some countries they have decreased. In others, they slightly increased. Comparing the tax wedge in 1996 and 2016, it turns out that with a general decrease in tax burdens in 8 EU countries, the tax wedge showed an upward trend. The fastest tax wedge increase took place in Malta (increase by 7.5 percentage points). However, it should be taken into account that it is the country with the lowest taxes (19% in 2016 only, and in 1996 only 11.9%). During the period of the crisis after 2008, in some countries there was a pressure to raise taxes in order to reduce the budget deficit. This concerned, among others countries such as Greece, Spain and Portugal, where international organizations, in exchange for financial assistance, forced governments to take actions to discipline public finances.

Figure1 Tax Wedge for a Single, Childless Person Earning 67% of Average Wages in EU Countries (%)



Source: Eurostat – Data Explorer, Tax Wedge on Labour Costs,
<http://appsso.eurostat.ec.europa.eu/nui/print.do> (11.05.2018)

The tax wedge is calculated for various types of households differentiated in terms of family income, number working persons in the family and their income, and the number of children.

Table 1 Tax Wedge for a Single, Childless Person, Earning 67% and 167% of Average Wages in Selected EU Countries (%)

Wyszczególnienie	2000			2017		
	67%	167%	Difference (p.p)	67%	167%	Difference (p.p)
Ireland	18	39	21	21	38	17
Luxembourg	30	44	14	29	44	15
Italy	44	51	8	41	54	13
Belgium	51	63	11	47	60	12
Finland	43	53	10	37	49	12
France	44	52	9	43	54	12
...
Czech Republic	41	45	4	41	45	5
Slovak Republic	41	45	5	39	44	4
Estonia	40	43	3	38	40	2
Latvia	42	44	3	42	44	2
Poland	37	39	2	35	36	1
Hungary	51	59	8	46	46	0

Source: Own study based on OECD 2018,
<http://stats.oecd.org/Index.aspx?DataSetCode=AWCOMP> (11.05.2018)

A comparison of the tax wedge amount of single, childless persons, earning 67% and 167% of the average wage in selected EU countries (Table 1) and the analysis of changes that took place in 2017 compared to 2000 lead to the following conclusions:

1) In the Western Europe countries, the tax burden on labour is high. At the same time, however, in most of these countries, differences between the tax wedge of persons earning 67% and 167% of the average wage are usually several percentage points.

2) The attention is paid by the relatively high level of tax wedge for low paid earners in Eastern European countries, at the same time with not very high taxes for higher paid earners, which means that the labour tax system to a small extent in these countries is used to redistribute income. In the Czech Republic, Estonia, Slovakia and Hungary a flat tax applies. In Poland, although there are two rates: PIT-18% and 32%, the income of over 98% of taxpayers is settled at a lower rate, and the tax allowance amount is also low. This causes that the difference between taxes of persons earning 67% and 167% accounted for only 2 percentage points in 2000 and 1 percentage point in 2017. It put Poland in the penultimate place in the EU before Hungary, where both groups of employees pay equal labour taxes.

3) In the last several years, changes in labour taxation have been aiming towards lowering the tax wedge and increasing the redistributive function of labour taxation. To the largest extent, such activities were undertaken in Western European countries and were a reaction to the global crisis initiated in 2008. An important element of anti-crisis packages were changes in the income taxation system aimed at increasing global demand, such as raising tax allowance amount, implementing or extending tax reliefs addressed mainly to large families and disadvantaged families, reducing the lower rates of PIT. The situation on the labour market also forced a change in social security contributions. As part of the fight against unemployment, mainly among younger and poorly educated people, actions were taken to lower the contributions (Krajewska, 2012, pp. 215-224).

An important element of the structure of labour taxation is to take into account the taxpayer's ability to pay and his/her family status. It is possible, among others through the use of pro-family relief system. The experience of European Union countries on taking into account pro-family aspects in the tax system is very diverse. This is evidenced by the data included in Table 2 presenting a tax wedge for a single person, childless, earning 67% of the average wage and a single person receiving the same remuneration, but raising two children in 2000 and 2017.

As far as labour taxation system, in Poland, the family situation of the taxpayer has not been taken into account for many years. For example, in 2000, the difference between the tax burden of a single person earning 67% of the average wage, childless and with two children, was only 7 percentage points. This defect of the tax system has been repeatedly pointed out in Poland (Kryńska 2014, Rekas 2012, Nadolny 2009, Ślesicka 2011). In 2007 a relief based on a tax deduction was introduced, but it was not beneficial for people with low incomes (Budlewska, 2016, pp. 729-730). Only changes introduced in 2014⁴ made Poland the best in this respect compared to EU countries. The next such example is Ireland, where the payment of grants for children made that net wages were higher than gross wages.

Clear tax preferences related to bringing up children are also found in the tax systems of Denmark, Luxembourg and the Netherlands, as well as Slovenia. The lowest level of family redistribution was marked in Greece, where single people paid taxes only by 4 percentage points smaller than those bringing up two children.

Table 2 Tax Wedge for a Single Person Earning 67% of Average Wage, Childless and Having Two Children in Selected EU Countries (%)

Specification	2000			2017		
	without children	with 2 children	Difference (p.p)	without children	with 2 children	Difference (p.p)
Poland	37	30	7	35	-21	56
Ireland	18	-1	19	21	-17	38

⁴Starting from 2014, the portion of the pro-family relief, which is not deducted due to insufficient tax, is refunded to the taxpayer, however, in the amount not higher than the sum of social security and health insurance contributions deducted in the tax return.

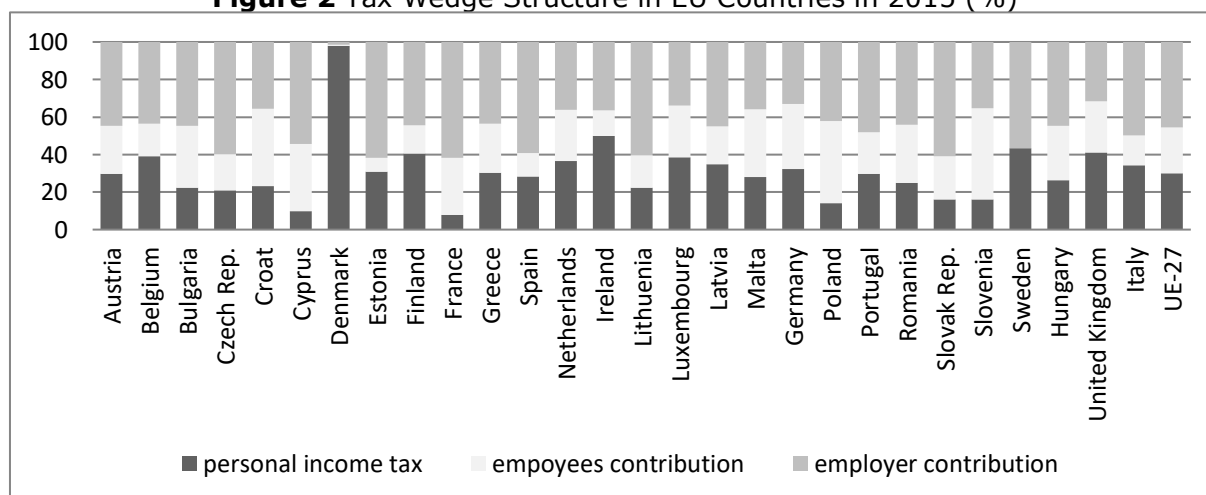
Denmark	38	12	26	34	6	28
Slovenia	43	13	30	40	13	27
Luxembourg	30	4	26	29	5	24
Netherlands	42	26	16	31	7	24
...
Czech Republic	41	13	28	41	22	19
Belgium	51	36	15	47	33	14
Slovak Republic	41	25	16	39	28	11
Finland	43	28	15	37	26	11
Sweden	49	40	9	41	34	7
Greece	36	35	1	37	33	4

Source: Own study based on OECD 2018,
<http://stats.oecd.org/Index.aspx?DataSetCode=AWCOMP> (11.05.2018)

4 Internal structure of tax wedge

The tax wedge consists of two main parts: personal income tax of persons receiving income from work (PIT) and insurance contributions charged to employees and employers. Other taxes burdening work are found only in some countries and, moreover, they are rarely more than 1% of the entire tax wedge. They will therefore be omitted from this analysis.

Figure 2 Tax Wedge Structure in EU Countries in 2015 (%)



Source: Own study based on: Rogers, Phillipe (2015, p. 7)

Graph 2 presents data on the internal structure of the tax wedge in 2015. Tax reforms have been carried out for years in EU countries, although they were based on similar principles, they had to take into account historical legacy and social conditions. For this reason, the labour taxation systems are very diversified in the European Union. The internal structure of the tax wedge is also diversified.

Here are two extreme examples: Cyprus and Denmark. In Cyprus, not only, as it already was referred to earlier, the tax wedge was very low in 2015 (19.2%), but the internal structure of labour taxation was also atypical. Income tax accounted for only 1.9% of the labour cost (gross pay plus contributions covered by the employer). Admittedly, income taxation is progressive with rates of: 0, 20, 25, 30 and 35%, but at the same time a high tax allowance amount (EUR 19.500) caused that this tax was hardly noticeable by an employee earning an average income. Also, social security contributions burdened the employer more than the employee. In turn, Denmark is unusual for another reason. Income taxes are high and, in addition, account for almost 98% of the tax wedge. Income tax consists of two parts: a progressive central tax supporting the state budget and a municipal, a flat tax contributing to the local budget and the church, set by local authorities

at a quite high level (22-28%). In turn, the social security contribution is low (2.1% of the total labour tax burden).

In Western European countries, as a rule, the share of income tax in the tax wedge is higher than in the new Member States. In Poland, this share is maintained at a particularly low level, in 2015: 14.1% total labour tax burden (compared to an average of 30% to EU-28). This can be explained by referring to the beginnings of taxation reform in Poland. Then, enterprises paid 20% tax on payroll fund and high contributions (45% of the payroll fund for social security + 3% for the Labour Fund). In 1992, a personal income tax with three rates was introduced: 20%, 30% and 40%. The first tax rate (20%) was so defined that it included over 90% of taxpayers. It allowed to introduce the universal income tax efficiently and without social resistance. The rates for health and social insurance have remained at the previous level. This, however, meant a serious limitation of the redistributive function, and also led to a distortion of the internal structure of the tax wedge.

The high level of tax wedge in Poland, accompanied by its low progressivity and incorrect structure leads to many negative effects, among others:

- unemployment in the group of people with low earnings,
- malfunctioning of the labour market and development of the shadow economy in order to avoid paying taxes and contributions,
- deepening of poverty among people with low earnings.

5 Conclusions

Analysis of statistical data on labour taxation in European Union countries makes it possible to formulate the following conclusions:

1) In Poland, the average level of the tax wedge is, against the background of the European Union countries, moderate. However, it is characterized by very low progressivity, taking on the account the level of income, and until 2014 also the taxpayer's family situation. It is unfavourable for professional groups with low qualifications and low earnings, because it is difficult to enter the labour market and it is difficult to maintain on it. It seems, therefore, appropriate increasing the progressiveness of income tax, among others, by raising the amount of tax allowance and increasing the number of tax thresholds.

2) There are large differences in the internal structure of the tax wedge in the European Union. The high share of contributions in the total tax wedge and the resulting negative consequences for the labour market caused that in many countries measures have been taken to reduce the tax burden of contributions, especially for some groups of employees – unqualified low-income earners, taking their first job, etc.

3) In Poland, the structure of the tax wedge is atypical. Poland was on the last place among EU countries in terms of social security contributions percentage in total tax wedge (85.5%). The high share of contributions is badly assessed by Polish entrepreneurs as it leads to an increase in labour costs, it lowers the competitiveness of Polish enterprises and leads to the development of grey zone. At the same time, however, reducing the share of social security contributions in relation to budget revenues from taxes and to GDP is difficult due to the situation on the labour market and relations of people who work and pay contributions to non-working, pensioners. Possible changes would, therefore, have to relate not only to contributions, but to the entire taxation system. More often, in this context, attempts are being made to discuss the concept of a single tax on labour.

References

- Andersson K., Norman E. (1987). *Capital taxation and neutrality*. Lund: Lund University.
- Budlewska R. (2016). Ulga na dzieci jako instrument realizacji polityki prorodzinnej w Polsce. In: *Oeconomica, Annales Universitatis Mariae Curie-Skłodowska*. Lublin, vol. L, p. 1.

- Dolenec P., Laporsek S. (2010). Tax Wedge on Labour and its Effects on Employment growth in the European Union. *Prague Economic Papers*, vol. 2010(4).
- Eurostat – Data Explorer (2018). *Tax Wedge on Labour Costs*.
- Góra M., Radziwiłł A., Sowa A., Walewski M. (2006). *Tax Wedge and skills: case of Poland in the international perspective*. Warsaw: CASE, Center of Social and Economic Research, no 64.
- Krajewska, A. (2012). *Podatki w Unii Europejskiej*. Warsaw: PWE.
- Kryńska, E. (2014). Labour Taxation In Poland Compared to the Other OECD Countries. *Comparative Economic Research. Central and Eastern Europe*, vol. 17(3).
- Nadolny, Ł. (2009). Klin podatkowy w Polsce na tle krajów Unii Europejskiej. *Polityka Społeczna*, no. 5-6.
- Rogers J., Phillipe C. (2015). *The Tax Burden of Typical Workers in the EU-28*. Paris-Bruxelles: Institut Économique Molinari.
- OECD (2013). *Economic Outlook*, vol. 94.
- OECD (2014). *Taxing Wages 2014*. OECDiLibrary. Retrieved from: https://www.oecd-ilibrary.org/taxation/taxing-wages-2014_tax_wages-2014-en.
- Rękas, M. (2012). Ulgi prorodzinne jako element polityki rodzinnej w wybranych krajach UE. In: Sokołowski J., Rękas M., Wękrzyn G., red., *Ekonomia, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*. Wrocław.
- Ślesicka A. (2011). Stosowanie ulg i zwolnień w podatku dochodowym od osób fizycznych w państwach UE, *Ekonomia. Prace Naukowe Uniwersytetu Warszawskiego*, no. 26.
- European Commission (2017). *Taxation Trends in the European Union*. Luxembourg: Publications Office of the European Union.
- Tvrdon M. (2011). *Taxation on Labor in the Economic Union*. Retrieved from: <http://www.wseas.us/e-library>.
- Wojciechowski W. (2008). Skąd się bierze bezrobocie. *Zeszyty Forum Obywatelskiego Rozwoju*, vol. 2.

Taxation of Consumption in Poland. Redistribution and Fiscal Effects

Anna Krajewska¹, Katarzyna Osiecka²

¹College of Economics and Social Sciences
Warsaw University of Technology
Łukasiewicza 17, 09-400 Płock, Poland
E-mail: anna.krajewska@pw.edu.pl

²College of Economics and Social Sciences
Warsaw University of Technology
Łukasiewicza 17, 09-400 Płock, Poland
E-mail: katarzyna.osiecka@pw.edu.pl

Abstract: Consumption taxes constitute important source of budgetary revenues. In time of crisis the role of those taxes had raised – the rates of VAT and excise rose. The aim of this paper is to present those tendencies, and next to show their redistribution and fiscal results, mainly on Polish case. Redistribution tax effects are verified by 1) presentation of empirical research findings concerning VAT and excise burdens on households in Poland, in cross-section decyl groups and distinct social-economic groups. 2) comparison Gini's coefficient before and after taxation and transfers in Poland and in selected EU countries. Analysis of fiscal effects of consumption taxation is based on 1) demonstration of correlation between contribution of indirect taxes in GDP and shadow economy in EU countries, 2) showing dependency between level of taxes and shadow economy by the example of tobacco market in Poland. Last chapter of the article shows actions taken in Poland aimed on insulating tax system.

Keywords: consumption taxes, VAT, excise, redistribution, shadow economy

JEL codes: H20, H21, H25, H31, E62

1 Introduction

The aim of this paper is to analysis the role of consumption taxes in budget revenues and to show their redistribution and fiscal effects.

We start with statistical data showing big differences in the structure of budget revenues in EU countries and presentation of empirical research concerning impact of consumption taxes on redistribution of income. We also use Gini coefficients to present redistributive effects of tax and social policy. Moreover the relation between taxation of consumption and the size of the shadow economy is analysed. The stress is put on tobacco market in Poland.

In conclusion we show actions taken in Poland aimed on insulating tax system.

2 Taxation of consumption in European Union and Poland. Statistical data.

On average, in the EU-28 countries, consumption taxes account for about 30% of total budgetary revenues, but their share in the budgets of individual countries is highly diversified. In the 1970s analyses of the structure of taxes in Western Europe were conducted and the historical character of these differences was clearly emphasized - countries with a "southern" and "northern" tax mentality were distinguished [Hansmeyer, 1977, p. 570]. In countries with the "southern" mentality, the size of shadow economy is high, and the efficiency of the tax administration is low. In this situation, expanding consumption taxes, especially excise duty, can feed to the budget with tax revenues that "escape" direct taxes. In turn, in countries with the "northern" tax mentality, tax collection is higher, the share of taxes in GDP higher, and moreover, the state budget may be more based on income taxes. The first group included Greece, Italy, Portugal and Spain, while the second included Sweden, Denmark, Germany, Austria and Belgium. EU actions aimed at harmonizing VAT and selected excise products were aimed at both creating better conditions for the free movement of goods and services, as well as to achieve a better

balance between direct and indirect taxes. Tax and shadow economy details for different countries are shown in Table 1.

Table 1 Taxes and Shadow Economy

Country	Total taxes/GDP (2015) ^{a)}	Consumption taxes/Total taxation (2015) ^{a)}	Shadow economy (2017) ^{b)}
Germany	38,6	28,5	10,4
Belgium	45,1	29,3	15,6
Czech Republic	34,3	36,5	14,1
Poland	32,5	40,1	22,2
Romania	28,0	47,6	29,6
Bulgaria	29,0	53,5	26,3

Source: a) European Commission 2017, p. 193; b) Schnider 2017, p. 154

After the enlargement of the EU by 10 new members in 2004, and in the following years by 3 next members (Bulgaria, Romania and Croatia), there were again large differences in the structure of budget revenues. The new member states have a clearly "southern" structure of budget revenues. In 2015, indirect taxes in Bulgaria accounted for 53.5% of total tax revenue and 47.6% in Romania, while only 28.5% in Germany and 29.5% in Belgium.

The reasons why indirect taxes have become the most important source of the budget revenues result from economic difficulties which Poland and other transforming economies had to face. Revenues from the public sector were diminishing fast, the fiscal apparatus was inefficient and the tendency to avoid taxes was high. It was considered that VAT and excise duty, despite its drawbacks, could best guarantee the security and stability of public finances (Owsiak, 1997, p. 369 and others).

In Poland, in the years 2003-2015, indirect taxes were of 41.0-44,3% of total tax revenues (including obligatory social security contributions). The EU-28 average was 33.7-35.1%, so this means that in Poland the share of indirect taxes was by 6-7 percentage points higher. On the other hand, in the Czech Republic, indirect taxes accounted for 36.5% of total tax revenues, i.e. they were close to the EU-28 average.

The share of tax revenues from the sale of tobacco products and alcohol (VAT + excise duty) in the budget revenues from taxes is also significantly different: from 9.6% in Bulgaria to 1.2% in Germany. The budget revenues of several other new EU members from these taxes are relatively high: Romania 5.8%, Estonia 5%, Lithuania 5%, and Poland 5.1% (European Commission 2017, p. 195).

Table 2 VAT Standard Rates in the EU Member States, 2008-2017

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Belgium	21	21	21	21	21	21	21	21	21	21
Bulgaria	20	20	20	20	20	20	20	20	20	20
Czech Republic	19	19	20	20	20	21	21	21	21	21
Denmark	25	25	25	25	25	25	25	25	25	25
Germany	19	19	19	19	19	19	19	19	19	19
Estonia	18	20	20	20	20	20	20	20	20	20
Ireland	21	21,5	21	21	23	23	23	23	23	23
Greece	19	19	23	23	23	23	23	23	23	24
Spain	16	16	18	18	18	21	21	21	21	21
France	19,6	19,6	19,6	19,6	19,6	19,6	20	20	20	20
Croatia	22	22	23	23	25	25	25	25	25	25
Italy	20	20	20	20	21	21	22	22	22	22
Cyprus	15	15	15	15	17	18	19	19	19	19
Latvia	18	21	21	22	22	21	21	21	21	21
Lithuania	18	19	21	21	21	21	21	21	21	21

Luxembourg	15	15	15	15	15	15	15	17	17	17
Hungary	20	25	25	25	27	27	27	27	27	27
Malta	18	18	18	18	18	18	18	18	18	18
Netherlands	19	19	19	19	19	21	21	21	21	21
Austria	20	20	20	20	20	20	20	20	20	20
Poland	22	22	22	23	23	23	23	23	23	23
Portugal	20	20	21	23	23	23	23	23	23	23
Romania	19	19	24	24	24	24	24	24	20	19
Slovenia	20	20	20	20	20	22	22	22	22	22
Slovakia	19	19	19	20	20	20	20	20	20	20
Finland	22	22	23	23	23	24	24	24	24	24
Sweden	25	25	25	25	25	25	25	25	25	25
United Kingdom	17,5	15	17,5	20	20	20	20	20	20	20
EU-28	19,5	19,9	20,5	20,8	21,1	21,5	21,5	21,6	21,5	21,5

Source: DG Taxation and Customs Union

Consumption generally falls during the crisis, leading to a reduction in the share of indirect tax revenues. In this situation, the state can react in two ways: lowering consumption taxes in order to stimulate global demand or raise VAT and excise rates in order to maintain budget revenues. During the recent crisis of 2008-2010, the first of these types of activities was used very rarely. In 2008, Portugal lowered the standard VAT rate by 1 percentage point and in 2009 temporarily by 2.5 percentage points. The VAT was raised in the United Kingdom (but in the next year, the previous rate was returned), and in 2010 by 0.5 percentage points the VAT was raised in Ireland. In total, since 2008, a standard VAT rate has been raised in 20 out of the 28 EU countries (Table 2). To the largest extent, the standard VAT rate was raised in Hungary (from 20% to 27%) and in Greece (from 19% to 24%). In 2017, standard VAT rates were: 18% in Malta and 19% in Germany and 25% in Denmark, Sweden and Croatia. The 23% VAT rate in Poland is therefore high for European standards. In Poland, the standard VAT rate was raised (from 22 to 23%) in 2011, announcing that it will be valid for one year, at most two-three years. But this situation has lasted for 8 years and nothing foreshadows change.

In EU countries, VAT ensures about 60% of revenue from consumption taxes (European Commission, 2017, p. 22). It should be expected that the increase in VAT rates should positively affect the increase of budget revenues from this tax. Data presented in Table 3 indicate that there are no major changes in the share of VAT in tax revenues of EU countries.

Table 3 The Share of Consumption Taxes in the Budget Revenue from Taxes (in %)

Country	Total consumption taxes					
	2003	2005	2008	2010	2012	2015
EU-28	28,7	28,6	27,6	28,7	28,6	28,7
Portugal	38,2	41,0	37,6	37,4	37,7	35,7
Ireland	36,9	37,0	36,3	35,5	33,5	33,3
Italy	25,3	26,2	24,3	25,7	25,7	25,8
Belgium	24,3	24,7	24,0	24,5	23,3	22,8
Czech Republic	27,8	30,2	30,0	32,7	35,1	34,8
Poland	37,1	37,9	37,6	39,4	36,7	35,2
Croatia	50,2	49,2	46,5	47,5	49,0	50,1
Bulgaria	45,1	51,2	53,7	52,7	53,2	50,8
Slovakia	34,3	37,9	34,7	34,6	32,8	31,9

Source: European Commission 2017, p. 193

In addition to raising VAT rates, excise duty rates (in particular on fuels, tobacco and alcohol) have been raised many times in most EU countries (European Commission, 2011, p. 34).

3 Impact of consumption taxes on the redistribution of household income.

The high share of consumption taxes in total tax burdens, the increase in the standard VAT rate and the increase in excise duty rates in Poland have a negative impact on the situation of households, as:

- 1) it leads to a decrease in disposable income, which means that they can buy less products and services,
- 2) it causes socially undesirable redistributive effects, because consumption taxes due to their regressive nature lead to an increase in the diversification of household incomes in various cross-sections,
- 3) the decline in real incomes and the increase in prices caused by the increase in taxes prompts people to make purchases in the grey market, where products may be of inferior quality, come from an illegal source, may threaten your health and expose you to fraud, etc.

Interesting research on the redistributive consequences of taxation of individual consumption in Poland in the years 1995-2006 was carried out by Dobrowolska (2008). The main source of information was the unpublished GUS data from Household Budget Surveys. The data were aggregated up to the sixth level of grouping (subcategories) of the Polish Classification of Products and Services. The following conclusions arise from the statistical and econometric analyses:

- 1) In the analysed period, household burden with indirect taxes increased systematically. Average burdens of approximately 7.48% in 1995 increased to 11.23% in 2006.
- 2) Indirect taxes are the biggest burden for the poorest households, those in the 1st decile of income group. The average income burden with indirect taxes (for the period 1995-2006) was 11.88%, while in the X group they were lower than in other decile groups and amounted to 8.87%
- 3) The regressivity of indirect taxes is increasing. This is evidenced by the deepening difference between the burdens in the I and X decile group. In 1995, the burdens of households in the X decile group were 2.9 percentage points lower than the burdens of households from the I decile group. In 2006, differences in tax burdens increased to 5.28 percentage points.

When analysing the distribution of households' burdens with indirect taxes, Dobrowolska distinguishes five socio-economic groups: households of employees, households of employees using farms, households of farmers, households of self-employed entrepreneurs and households of pensioners. The analysis of the distribution of tax burdens in this cross-sections show that:

- 1) to the greatest extent, indirect taxes are borne by households of farmers (15.5% in 2006) and households of employees using farms; this is because these farms, apart from consumer goods, purchase VAT and excise duty products and services used for agricultural production;
- 2) the burden on self-employed entrepreneurs' is relatively high (11.38%), which can be partly explained by the higher level of consumption of this social group;
- 3) households of employees are burdened with indirect taxes to the smallest extend (10.5%) and pensioners (9.83%);
- 4) it turns out that in the analysed period, the burdens of households with the lowest incomes (pensioners) were growing faster (169.78%) and the slowest (139.29%) growth was that of the wealthiest households of self-employed entrepreneurs.

The next empirical studies conducted by Dziura (2015) concern households' excise duty burdens for the years 2004-2012. The obtained results confirm previous observations, but at the same time bring new threads resulting mainly from the analysis of not only household budgets, but also statistical data on shadow economy, mainly illegal trade in fuels, smuggling and illegal production of tobacco and alcohol.

The observations that especially deserve underlying are:

- 1) Poorer households are more heavily burdened with excise duty than the richest households (e.g. in 2004, this burden constituted 2.27% of net income in the first decile group, while in the X group it was much less - 1.79%), but the spread between these groups, during the analysed years reduced (in 2004 it was 0.48 pp, and in 2012 it decreased to 0.29 pp), i.e. the degree of regressivity is weakening.
- 2) Fiscal burdens of consumption with excise duty from year to year are decreasing (except in 2006 and 2008-2009, when there was a slight increase compared to previous years). This applies to both decile groups and types of households.
- 3) To the greatest extent, the households of self-employed entrepreneurs and pensioners are burdened with the excise duty

Dziura explains those trends by referring to changes in the consumption structure of various groups of households. The increase in excise tax on tobacco products and alcohols to a greater extent stimulated wider use of the shadow economy by poorer households, farmers and pensioners, and the increase in excise tax on motor fuels increased the excise duty burden on self-employed entrepreneurs' households.

The redistributive effects of tax policy can be measured by comparing Gini coefficients before tax and transfers, as well as after taxes and transfers. The data presented in Table 4 show that taxes and transfers are the main tool for redistribution in Germany - the difference in Gini coefficients in the analysed years was usually 24-28 pp. In Belgium, the difference in Gini's coefficient remained at a similar level of 20-21 pp, that is at a slightly higher level than in the Czech Republic, where taxes and transfers allowed for a reduction of the coefficient by around 20 pp. The redistribution tools were much weaker in Poland and Romania, and worst in Bulgaria, where since 2007 the high Gini coefficient, sometimes exceeding 50%, thanks to fiscal and social policy, was reduced by only a dozen (14-15) percentage points.

Table 4 Gini Coefficients Before and After Tax and Transfers in Selected EU Countries (in %)

Country	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gini coefficients before tax and transfers											
Belgium	48,7	46,7	48,0	46,6	46,5	47,1	47,7	47,1	47,6	48,0	48,8
Germany	55,2	54,4	56,0	54,4	55,4	55,5	54,4	56,4	57,7	56,4	55,5
Poland	53,0	51,4	49,8	48,2	47,9	47,8	47,5	47,7	47,9	47,9	46,7
Czech Republic	45,2	44,9	44,1	43,7	43,8	44,1	44,5	44,1	45,0	44,9	44,9
Bulgaria	52,8	50,4	49,7	46,4	46,7	48,1	47,5	49,1	50,8	51,6	52,8
Romania		55,6	54,7	54,0	53,2	53,4	52,9	53,8	53,2	53,2	53,3
Gini coefficients after tax and transfers											
Belgium	27,8	26,3	27,5	26,4	26,6	26,3	26,5	25,9	25,9	26,2	26,3
Germany	26,8	30,4	30,2	29,1	29,3	29,0	28,3	29,7	30,7	30,1	29,5
Poland	33,3	32,2	32,0	31,4	31,1	31,1	30,9	30,7	30,8	30,6	29,8
Czech Republic	25,3	25,3	24,7	25,1	24,9	25,2	24,9	24,6	25,1	25,0	25,1
Bulgaria	31,2	35,3	35,9	33,4	33,2	35,0	33,6	35,4	35,4	37,0	38,3
Romania		38,3	35,9	34,5	33,5	33,5	34,0	34,6	35,0	37,4	34,7
Difference between Gini coefficients before and after tax and transfers											
Belgium	20,9	20,4	20,5	20,2	19,9	20,8	21,2	21,2	21,7	21,8	22,5
Germany	28,4	24,0	25,8	25,3	26,1	26,5	26,1	26,7	27,0	26,3	26,0
Poland	19,7	19,2	17,8	16,8	16,8	16,7	16,6	17,0	17,1	17,3	16,9

Czech Republic	19,9	19,6	19,4	18,6	18,9	18,9	19,6	19,5	19,9	19,9	19,8
Bulgaria	21,6	15,1	13,8	13,0	13,5	13,1	13,9	13,7	15,4	14,6	14,5
Romania		17,3	18,8	19,5	19,7	19,9	18,9	19,2	18,2	15,8	18,6

Source: www.epp.eurostat.ec.europa.eu

4 Taxation of consumption and the size of the shadow economy

The concept of shadow economy is difficult to define precisely and unambiguously. Generally speaking, this term covers economic activities carried out outside the state registration and regulation, hence not subject to taxation. Therefore, the shadow economy includes both legal actions, but not reported to the tax office, as well as actions on the borderline of the law, as well as illegal and even mafia activities.

In the transforming economies, the shadow economy has already appeared in the initial phase of the transformation period, accounting for 23.4% of GDP in the countries of Central and Eastern Europe and 32.9% in the countries of the former USSR. At the turn of 2000-2001, the share of the shadow economy in the countries of Central and Eastern Europe increased to 29.2%, in the former USSR countries up to 44.8%, in some countries (Azerbaijan, Kazakhstan) exceeding even 60% (Schneider, 2010).

The main reasons for the rapid development of the shadow economy in transforming economies include: high tax burden that persuades individuals and businesses to evade taxes; high social security contributions that encourage private employers, especially those who do business to a small extent, to employ illegally and weak and inefficient tax administration system that makes tax collection low, and sanctions for tax evasion - low and inconsistently enforced (Krajewska, 2012, pp. 296-298).

According to a recent Schneider researches (2017), the share of shadow economy in GDP in the EU-28 countries was estimated at 29.6% (Bulgaria), 26.5% (Croatia) and 26.3% (Romania) to 8.2% (Luxembourg) and 7.1% (Austria), with an EU-28 average of 17.1%.

In Poland, estimations of the size of the shadow economy are published by the Central Statistical Office (CSA) and the Institute of Economic Forecasts and Analyses (IEFA), which, when examining the shadow economy, covers a wider group of entities than the Central Statistical Office. Both institutions indicate that the size of shadow economy is decreasing. According to the CSA, the share of the shadow economy in GDP is falling from 13.3% GDP in 2014 to 13.2% in 2017, and as estimated to 12.9% in 2018, and according to IEFA, respectively, from 19.5% GDP up to 18% (Fundowicz, Łapiński, Wyżnikiewicz, 2018, pp. 21-22).

Among the most important factors affecting the reduction of the shadow economy in recent years can be considered (Fundowicz, Łapiński, Wyżnikiewicz, 2018, p. 23):

- 1) favourable condition of the economic situation, encouraging enterprises to conduct activities not hidden from the tax office;
- 2) government action aimed at sealing the tax system, and in particular with regard to VAT collecting (mainly in the fuel sector);
- 3) effective fight against illegal activities - limitation of production and trade in drugs and designer drugs, decrease of cigarette smuggling, elimination of illegal gambling.

As an example, the market for tobacco products can serve to show the negative impact of the increase in excise tax on budget revenues. The shadow economy is particularly extensive there and covers two areas. The first one is the smuggling of cigarettes from the eastern border (Russia, Belarus, Ukraine) and their illegal sale in Poland. The second one is the illegal production of counterfeit goods from well-known brands and placing them on the market without applicable excise marks or illegal exports to Western Europe (mainly Germany, Great Britain, Sweden and Italy).

The big difference between the price of cigarettes in Poland and the eastern border is a serious incentive to smuggle tobacco products. For example, in 2015, the price of a packet

of cigarettes in Poland was PLN 12.85, while PLN 4.65 in Russia, 3.26 PLN in Belarus and PLN 3.20 in Ukraine (Skwirowski, 2016). Such a large difference in prices makes smuggling a deal for both organized gangs and small smugglers, so-called "Ants" - most often unemployed, pensioners crossing the border several times a day. Customs officers estimate that only in the Warmian-Masurian voivodship there are about 10,000 smugglers. This is confirmed by the data of the Central Statistical Office, which shows that the unemployment rate in most border-crossing entities with border crossings is decreasing much slower than the average in their voivodships, and slower than in poviats neighbouring with border counties (Fundowicz, Łapiński, Wyżnikiewicz, 2018, p. 19). This means that the proximity of the border is not conducive to take up legal activities.

On the other hand, the illegal production of tobacco products is encouraged by low production costs, simple technology, high taxation (VAT and excise duty account for over 80% of the price of cigarettes in Poland) and the possibility of illegal exports to Western European countries. High profits from illegal production make possible penalties in the case of detecting illegal activities are not perceived as onerous.

In the opinion of experts, the shadow economy on the tobacco market in Poland grew rapidly - from 12.3% in 2008 to 21% in 2012 and 25% (Poniatowski, Głowacki 2018). According to some estimates it reached 25-30% (Association of Entrepreneurs and Employers 2016).

To a large extent, the development of the shadow economy on the tobacco market results from the rapid increase in excise tax rates, especially in 2010-2014. During this period, the increase in excise duty rates exceeded the pace required by the EU's obligations regarding the harmonization of excise tax on tobacco products. The level of excise taxation required by the EU until 2018 has been reached or even exceeded in Poland already in 2014. However, this decision has had a negative impact on excise duty on tobacco products. In 2013-2015, excise tax revenues decreased in absolute terms, and in 2016 they increased slightly, but the percentage of total excise tax on tobacco products in total tax revenues was still lower than in 2010 (Table 5).

Table 5 Budget Revenues from Excise Tax on Tobacco Products in Poland

	Tax income (in PLN billion)	Revenues from excise tax on tobacco products	
		in PLN billion	in %
2010	222,5	17,4	7,8
2011	243,2	18,3	7,5
2012	248,3	18,6	7,5
2013	241,6	18,2	7,5
2014	254,8	17,8	7,0
2015	259,7	17,8	6,9
2016	273,1	18,5	6,9

Source: Own study based on the Statistical Yearbooks of the Central Statistical Office

5 Conclusions

The Polish tax system is very much based on consumption taxes. The share of VAT and excise duties in budget revenues from taxes is high. The standard VAT rate (23%) is one of the highest in EU countries. The rates of excise tax are also high. This leads to negative effects, both for households (reduced disposable income, and the regressivity of indirect taxes which deepens social disparities), as well as for the economy (a large share of the shadow economy with its negative consequences).

In recent years, various measures have been taken in Poland to strengthen the fiscal function of consumption taxes, e.g., increasing the collection of VAT and excise taxes, limiting cash turnover and replacing it with non-cash transactions, implementing a monitoring system for transporting sensitive goods (the obligation to report the carriage of so-called "sensitive" goods) to and through Poland to the electronic register and its ongoing updating, also introducing legislative changes to limit the shadow economy on the

tobacco market. The effects of these activities are now visible and according to EU estimates in 2015, the so-called VAT gap was 23.9% of potential revenues, while the EU average was 12.8%. In 2017, the gap was at the level of 14%, which is close to the average recorded in the EU. In Poland, VAT revenues increased by 0.4% of GDP, while only France, Malta, Cyprus and the Netherlands managed better with the VAT collection (Cieślak-Wróblewska 2018).

The impact on reducing the negative redistributive effects of VAT and excise duty is a wider problem, going beyond the reform of indirect taxes. These should be comprehensive activities, including an increase in the redistributive income tax function (increase in the amount of tax-free income, increasing tax progression), reform of social security contributions, as well as the introduction of cadastral tax.

References

- Cieślak-Wróblewska, A. (2018). Polska szybko nadrabia straty podatkowe. *Rzeczpospolita*.
- Dobrowolska, B. (2008). *Ekonomiczne konsekwencje opodatkowania konsumpcji indywidualnej w procesie integracji z Unią Europejską*. Łódź: Uniwersytet Łódzki.
- Dziura, E. (2015). *Obciążenia gospodarstw domowych podatkiem akcyzowym w Polsce. Uwarunkowania, konsekwencje, perspektywy*. Lublin: Uniwersytet Marii Curie-Skłodowskiej.
- European Commission (2011). *Taxation trends in the European Union. Focus on the crisis. The main impacts*. Retrieved from: <http://ec.europa.eu/eurostat/web/products-statistical-books/-/KS-EU-11-001?inheritRedirect=true>
- European Commission (2017). *Taxation trends in the European Union*. Luxembourg: Publications Office of the European Union.
- Fundowicz, J., Łapiński, K., Wyżnikiewicz, B. (2018). *Szara strefa 2018*. Warszawa: IPIAG.
- GUS (2010-2016). *Roczniki Statystyczne*. Warszawa: GUS.
- Hansmeyer, K. H., Mackscheidt, K. (1977). *Finanzpsychologie*. Tübingen: Hdb. d. Fin.
- Krajewska, A. (2012). *Podatki w Unii Europejskiej*. Warszawa: PWE.
- Owsiak, S. (1997). *Finanse publiczne. Teoria i praktyka*. Warszawa: PWN.
- Poniatowski, G., Głowacki, K. (2018). *Wpływ produkcji wyrobów tytoniowych na polską gospodarkę*. Warszawa: Centrum Analiz Społeczno-Ekonomicznych.
- Schneider, F. (2017). *Implausible Large Differences of the Size of the Underground Economies in Highly Developed European Countries? A Comparison of Different Estimation Methods*. Retrieved from: http://www.econ.jku.at/members/Schneider/files/publications/2017/EstShadEc_OECD/countries.pdf
- Schneider, F. (2010). The Size and Development of the Shadow Economies and Shadow Economy Labour Force of 22 Transition and 21 OECD Countries: What Do We Really Know?. In: *Referat na konferencję Unofficial Activities in Transition Countries: Ten Years of Experience*. Zagrzeb: Friedrich Ebert Stiftung, Institute za Javne Financije, pp. 18-19.10.
- Skwirowski, P. (2016). Jak walczyć z Szarym paleniem. *Gazeta Wyborcza*.
- Szara strefa to nieuczciwa konkurencja* (2016). Warszawa: Związek Przedsiębiorców i Pracodawców.

Problems in the Banking Sector

Jan Krajíček

Masaryk University
Faculty Economics and administration, Department Finance
Lipová 41a, 602 00 Brno, Czech Republic
E-mail: krajicek@econ.muni.cz

Abstract: *The paper dedicated to some problems in the banking sector. Banks have different problems. Are some different between great, middle and small banks. Conditions that affect it and the possibilities for further development. Emphasis placed on the development of interest rates and their impact on the economy and management of banks. The decline in interest rates would itself be a problem for banks such as resources grow in the banking sector. Growth in deposits not only in banking, but in the financial sector, and has its consequent reflection in both the declining risk aversion and the need to create new products and services. The decline in risk aversion also reflected in the design of new products, where risk is transferred to raise immediate profits problems are dependent on the size of the bank. Large banks have different problems than medium and small banks, due to their client focus.*

Keywords: bank, loans, revenue, risk

JEL codes: C15, E37, E42, G20, G21

1 Introduction

Management of Balance sheet credits his structure forms the crux of bank management and is an essential part of the financial management of the bank. It's a way of managing the balance sheet structure of the bank, which is an overview of the bank's assets and sources of its financing (Krajicek 2017).

Management of assets and liabilities refers to the bank as a whole. Bank to manage bank risk diversification, risk limitation specifying upper and lower volumes borders while respecting the criteria of profitability and bank profitability. When management assets and liabilities of the bank always acts in the space defined by the central bank and must respect its actions regarding prudent banking and monetary policy. While it is necessary to understand the management of assets and liabilities as a whole, management liability has its rules and peculiarities, by analogy Asset Management which is followed by risk management.

Influence of credit risk on the bank's economy:

- It has a direct impact on the bank's profit, which reduced as a result of provisioning, write-off of loans granted, the creation of reserves and lower interest income of the bank;
- It is closely related to liquidity:
 - Instead of becoming a liquid asset from an illiquid asset, the balance remains an illiquid item,
 - Interest payments for missing resources drain bank liquidity,
 - The resources used in the credit relationship not valued as a result of interest payments,
 - The credit principal was not returned, causing the bank's cash flow,
- There is also a fundamental relationship between credit risk and the risk of interest rate movements. When changing interest rates to the detriment of the borrower, the credit risk increases.
- The ultimate effect of credit risk growth is the pressure to reduce staffing. A lower number of employees reduces labor costs and consequently increases undistributed earnings during the year and profit at the end of the year. There has a positive impact on bank regulation indicators.

The risk of a loan portfolio in the area of credit operations of a bank is necessary to manage and monitor not only the risk of specific loans but also the risk of the entire loan portfolio. The more diversified the structure of the loan portfolio, the lower the bank's credit risk. High concentration per client, an economically linked group of clients, to one economic sector or region, the bank's credit risk is always substantially increased.

2 Methodology and Data Banking sector

For the stable development of the bank is a necessary qualified asset and liability management, which form the focus of bank management and is an essential part of the financial management of the bank. It's a method of managing the balance sheet structure of the bank, which is an overview of the bank's assets and sources of its funding, with the aim of maximizing profits.

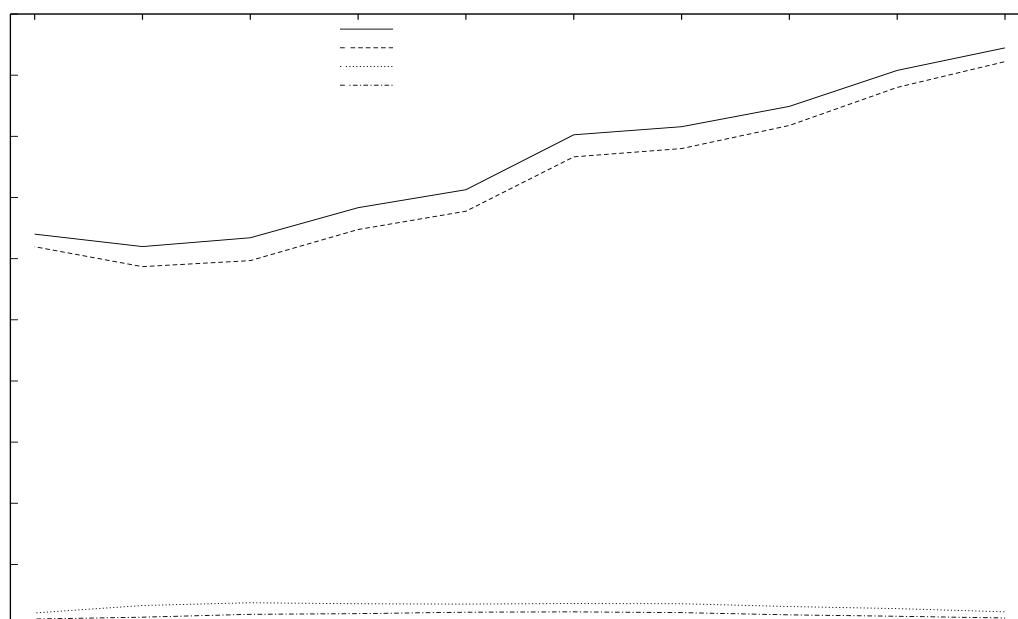
To bank management also reflects the macroeconomic effects of regulation of the banking sector in particular, as currently applicable to Basel II and Basel III, banks are implanted Slovík and Cournede (2011).

The paper mainly used for data analysis, which is available in the system ARAD CNB (2018). The analysis is focused exclusively on the Czech Republic for which data are available over a sufficiently long time series, which allows the adoption of conclusions. Use of a literature search is limited primarily to the basic literature, which dedicated to banks and their evaluation.

The decisive is considered primarily an analysis of profits about the development of, particularly interest rates, interest rates and risks in the banking sector. For purposes of evaluating risk, development again used data from ARAD CNB (2018).

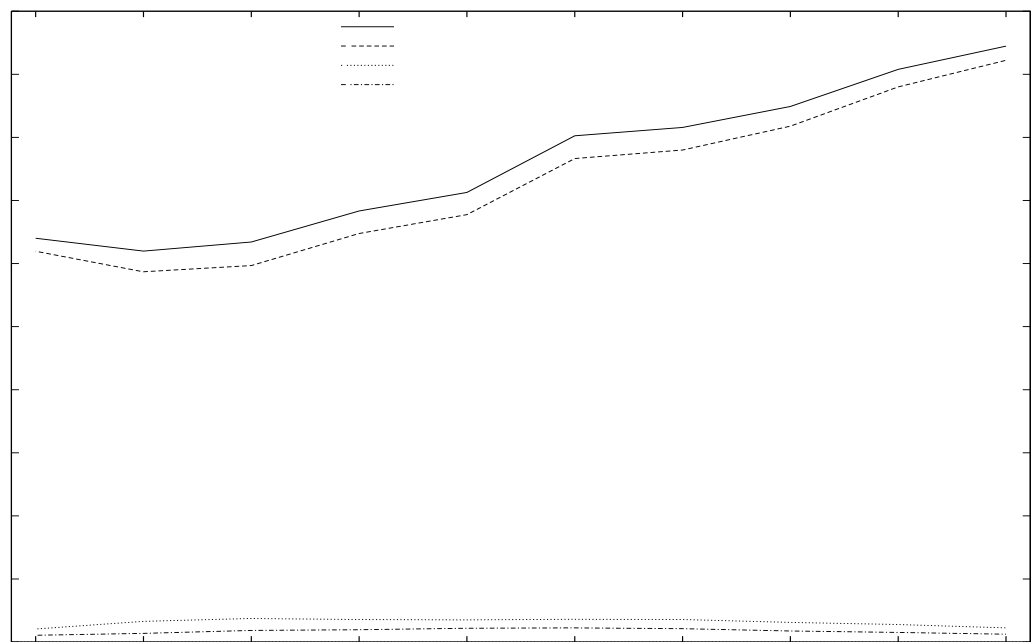
The crucial focus is not on how to analyze the current situation in the banking sector, especially the excess of liabilities reflected in the financial results of individual bank groups. As the basis for the analysis used data ARAD CNB (2018). Their classification is according to the size of banks on small, medium and large banks. Development of receivables demonstrates the following figure.

Figure 1 Receivables in Banks Total



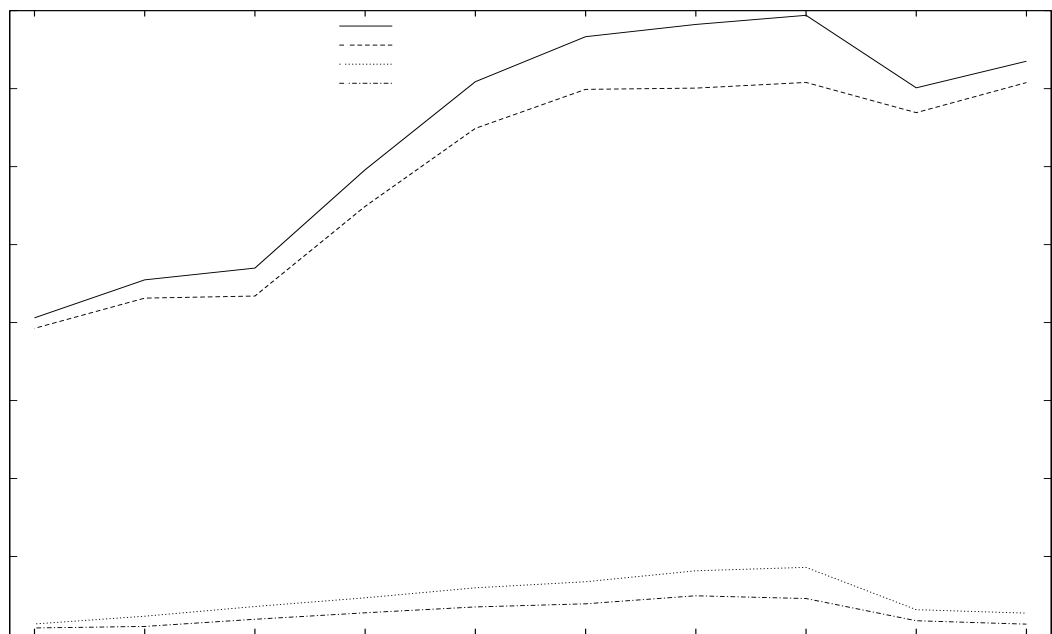
Source: Own processing on basis data ARAD CNB (2018)

Figure 2 Receivables in Great Banks



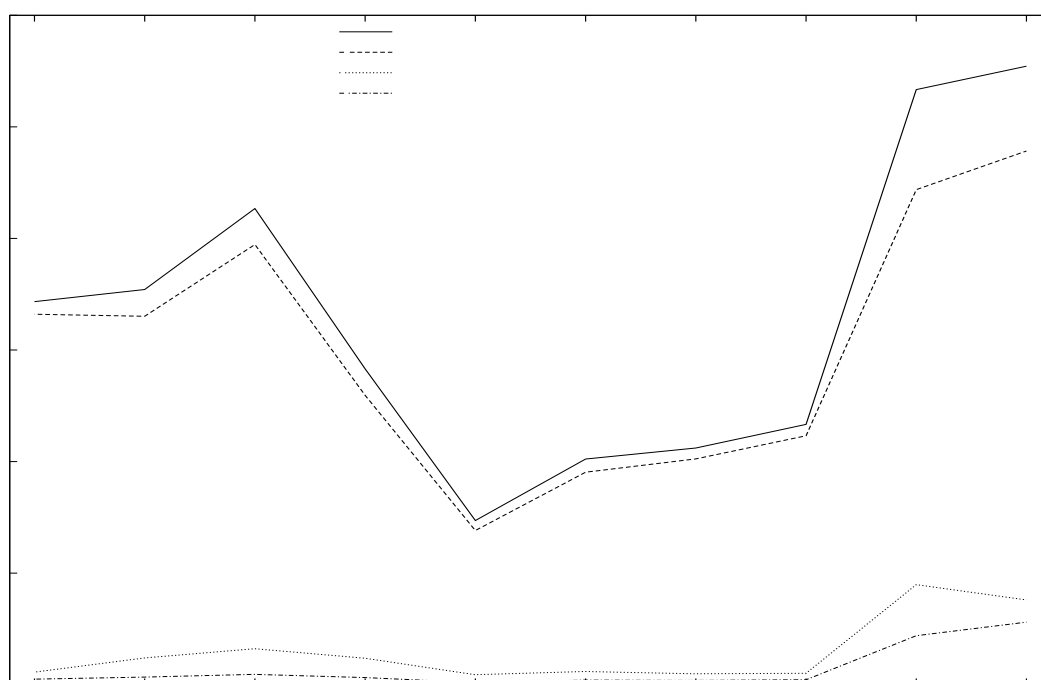
Source: Own processing on basis data ARAD CNB (2018)

Figure 3 Receivables in Middle Banks



Source: Own processing on basis data ARAD CNB (2018)

Figure 4 Receivables in Small Banks



Source: Own processing on basis data ARAD CNB (2018)

3 Results and Discussion

The analysis is based exclusively on available data published by the CNB. It focuses exclusively on the Czech Republic, for which data are available in sufficiently long time ranges, which allow me to take relevant conclusions.

The banking sector has a very balanced development of receivables without default, which evolves in line with total receivables, due to a significant increase in receivables. At the same time, there is a slight decrease in receivables in default and loss receivables. However, it is fundamentally different if we focus on banks related to their client orientation and size. The size of the bank also determines their orientation.

The current developments, when interest rates on deposits have declined significantly, with the current excess of liquidity in Czech banks, are strongly reflected in their orientations. Especially small banks are trying to find a trick on the market. Critical for them is the provision of retail loans. Here, however, they are beginning to get more and more into battles with non-bank providers of consumer credit.

Large banks have the advantage both in their client portfolio and thus not endangered.

The key problem remains with medium-sized banks that are trying to compete with large banks by taking corporate clients and pushing for consumer credit.

The current favorable development in the portion of the loan in default in the loan portfolio also influenced by the growth in the absolute value of the loan portfolio. The portion of defaulting credit also reflected in the relatively short credit expansion period, particularly in the area of retail loans and housing loans. With a prolonged credit expansion period, risk aversion to banks will decline as a result of high deposits. It can assume that this will result in a significant increase in default credit.

The following charts document developments in the banking sector, and it is likely that small banks will be expected to expect problems in the future.

4 Conclusions

Development of economic indicators in the banking sector at the current low-interest rates depends mainly on the orientation of the bank, the result of the woods reach small banks.

For further development of the banking sector and individual banks, it is crucial:

- Client orientation of the bank, whether the bank-oriented to corporate clientele, retail, mortgage lending,
- The size of the bank, which closely linked to the ability of the bank to focus on client demand,
- The size of the bank at the same time also has a decisive influence on the Bank's potential for further development.
- In particular, small banks are expected to increase outstanding loans, which are related to their expansion policy.

Acknowledgments

Support of Masaryk University within the project MUNI/A/0753/2017 is gratefully acknowledged.

References

- Heffernan, S. (2005). *Modern Banking*. 1.rst. Ed. Chichester: John Wiley & Sons.
- Krajicek, J. (2017). *Economics and Management of Banks*. 3rd upgraded and revised edition. Brno: Masaryk University, Faculty of economics and administration, Department of Finance. Study texts.
- Slovik, P., Cournede, B. (2011). Macroeconomic Impact of Basel III. *OECD Economics Department Working Papers*, vol. 844.
- CNB (2018). *The time series Database*. Retrieved from: http://www.cnb.cz/cnb/STAT.ARADY_PKG.STROM_DRILL?p_strid=0&p_lang=CS

The Impact of Behavioral Finance on the Financial Performance of an Enterprise

Peter Krištofík¹, Michaela Novotná²

¹ Matej Bel University
Faculty of Economics, Department of Finance and Accounting
Tajovského 10, 975 90 Banská Bystrica, Slovakia
E-mail: peter.kristofik@umb.sk

² Matej Bel University
Faculty of Economics, Department of Finance and Accounting
Tajovského 10, 975 90 Banská Bystrica, Slovakia
E-mail: michaela.novotna@umb.sk

Abstract: Behavioral finance is an increasingly accepted approach to explaining human behavior in the market. Traditional financial theories treat financial markets and their participants as rational subjects. This paper focuses on behavioral finance and its impact on Slovak medium and large enterprises. It points to different perceptions of rationality in classical economics and behavioral economics. The aim is to create a linear regression model and to investigate the impact of deviations from the rationality on the company's financial performance, measured through ROA and ROE. The paper employs a primary data source: a questionnaire survey, completed by 33 corporate managers. It tests six linear regression models. These show that deviations from rationality, and age affect the financial performance of enterprises.

Keywords: behavioral economics, behavioral finance, deviations from rationality, regression models, financial performance of enterprises

JEL codes: G02, C58

1 Introduction

Traditional financial theories treat participants in financial markets as rational subjects. They assume that if new information emerges on the market, entities will adjust their preferences and attitudes rationally. They then take decisions that are in line with the theory of maximizing their personal benefit. The theory of rational behavior thus appears to be clear, well defined, standing on logical foundations. It would be sufficient if its forecasts were confirmed by practice. However, after many years and especially in today's chaos on the financial markets, it is clear that such theories cannot be fully applied to the real world of people, especially in terms of individual investor behavior.

This is related to the emergence of behavioral economics and behavioral finance. The central theme of these disciplines is precisely economic decision-making - the way in which we decide, the possible causes of our action, and possibly its inconsistency with economic rationality.

Behavioral approaches used to address the variety of financial problems are referred to as behavioral finance. Behavioral finance represents a new approach to financial markets that has emerged in response to a totally inappropriate model of rational behavior.

Kahneman and Tversky (1979) describe several classes of choice problems in which preferences systematically violate the axioms of expected utility theory. In the light of these observations they argue that utility theory, as it is commonly interpreted and applied, is not an adequate descriptive model. They propose an alternative account of choice under risk. This is prospect theory: a response to the inability of the theory of expected utility to explain certain phenomena that seem to conflict with its underlying assumption that people behave perfectly rationally. Prospect theory suggests that there may be limitations to human thinking that lead to a systematic violation of the underlying assumptions of probability theory.

Psychology and neurology have shown that a person does not always only act rationally. In addition to reason, emotions are important for behavior, even to a greater extent than logical considerations. Most decisions are made on the basis of intuitive approaches that arise from personal preferences and character traits. Some deviations from rationality are called adaptable, because they allow people to adapt to certain situations and take more rapid and hence efficient solutions. Other deviations from rationality arise as a result of people failing to develop proper mental mechanisms to solve certain problems or using mechanisms that are ill suited to dealing with these specific problems (Pilch, 2014).

As Pilch (2014) states, deviations from rationality can occur at any stage of the decision-making process, starting from the form in which the new information is presented, and continuing until the decision is taken. The decision-making process has several phases, each of which can be changed significantly.

Furthermore, we may sort the deviations from rational behavior on whether they result from incorrect information processing, or from the personal characteristics of the investor. Accordingly, we divide them into cognitive and emotional (Baláž, 2006).

Cognitive deviations from rational behavior are based on incorrect collection, analysis, and interpretation of information. They can be corrected by learning, or by appropriate financial counseling (Pilch, 2014a).

Emotional deviations from rationality in thinking and acting are conditioned by emotional factors, especially by desire and concern. Not every emotion is an expression of irrationality. Emotions, however, support the adoption of fast and economical decisions. These are especially beneficial when the problems are very complex and their rational solution would take more time than is tolerable. In certain situations, emotions can suppress rational thinking and result in mistaken or irrational behavior.

2 Methodology and Data

The aim of the paper is to point out the importance of psychological aspects in decision-making and the dependence between the financial performance of an enterprise and deviations from rational behavior. Based on the results of empirical studies, we assume that the performance of a company measured through the ROA and ROE has a strong impact on cognitive, emotional and mixed deviations from rationality.

We used a primary data source, specifically a questionnaire survey. The aim of the questionnaire was to determine the presence of selected deviations from rationality on the part of the respondents. We chose the most frequent deviations from rationality, and the questions were formulated on the basis of various previous research. The questionnaire consisted of closed questions with one choice of answer, and closed questions with multiple choices of answer. The questionnaire was completed by 33 corporate managers. The group of managers comprised 26 men (78.79%) and 7 women (21.21%). All the managers who worked for the addressed companies had work experience of over 12 months.

After evaluation, we created regression models, where the dependent variable was ROA or ROE, and the independent variables were individual distortions, age, and respondent gender.

The ROA was calculated as the share of the economic result before tax and the deduction of interest (referred to as EBIT), and total assets. We measured ROE as a share of net profit and equity.

We will use data from the results of the questionnaire survey and the information we have been able to obtain from our financial statements about the companies' financial performance.

3 Results and Discussion

We began with a regression model with the ROA indicator as the dependent variable. In the first model we only examined the effect of deviations from rationality on this indicator

and we call it Model 1. Firstly, we evaluated the statistical significance of the individual variables entering the model. For all our models we tested the hypotheses:

$H_0: \beta_i = 0$, the variable is statistically insignificant,

$H_1: \beta_i \neq 0$, so the variable is statistically significant, it is not zero.

For Model 1, the p-value of all indicators is less than the significance level $\alpha = 0.05$, hence we not reject H_0 , and all the variables are statistically significant. Then we evaluate the sign of each of the regressive coefficients. A negative sign "-" represents indirect proportionality, and a positive sign "+" represents direct proportionality. If we have a negative sign for all regression coefficients, this implies that if the number of individual deviations from rationality increases, economic performance, measured by the ROA indicator, will decrease. Our first linear regression model, Model 1 has the form:

$$y_i = 0.29549 + (-0.03030 \text{ Overconfidence bias}) + (-0.03172 \text{ Aversion to loss}) + (-0.02707 \text{ Aversion to loss and willingness to risk}) + (-0.02895 \text{ Availability}) + (-0.03491 \text{ Overestimate of low probabilities}) + (-0.02862 \text{ Mental accounting 1}) + (-0.02824 \text{ Mental accounting 2}) + (-0.03213 \text{ Myopia 1}) + (-0.02361 \text{ Myopia 2}) + (-0.03203 \text{ Anchoring effect}) \quad (1)$$

The importance of all models as a whole was tested by the F-test. We tested the hypothesis:

$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$,

$H_1: \text{non } H_0$.

Model 1 as a whole can be evaluated as statistically significant because the p-value of the F-statistic is 6.3E-143, and thus we reject the null hypothesis about the non-importance of the model. Furthermore, the model as a whole is evaluated using the R^2 coefficient of determination. It states, after multiplying by 100, the percentage variability that can be explained by the variability of the independent variables in a given model. The closer the coefficient of determination is to 100%, the better the model. Our Model 1 has an R^2 value of 84.39%. So approximately 84.39% of ROA indicator changes depend on deviations from rationality. The disadvantage of this coefficient is that if we add parameters, its value will increase. This disadvantage is removed by calculating the adjusted (corrected) determinant coefficient R^2_{adj} . This adjusts for the number of variables, and like R^2 the higher its value, the better the model. In our Model 1 it is 83.97%.

In the second model, Model 2, we examine the impact of all deviations from rationality, age and gender on the ROA indicator. First, we again evaluated the statistical significance of each variable. The P-value of the statistical gender variable is very high and therefore, at all current levels of significance, the zero hypothesis is not rejected and the gender variable is statistically insignificant. All other p-values are less than the significance level $\alpha = 0.05$, so we can reject the H_0 hypothesis and all other variables are statistically significant. For the variable age, there is a positive sign, which is a direct dependence, and therefore with the manager's increasing age, the financial performance of the business measured through the ROA indicator also increases. The sign of variables that represent deviations from rationality are negative, indicating indirect dependence. Based on the calculated coefficients, Model 2 will have the form:

$$y_i = 0.13285 + 0.00355 \text{ Age} + (-0.02528 \text{ Overconfidence bias}) + (-0.02754 \text{ Aversion to loss}) + (-0.02250 \text{ Aversion to loss and willingness to risk}) + (-0.01997 \text{ Availability}) + (-0.02724 \text{ Overestimate of low probabilities}) + (-0.02055 \text{ Mental accounting 1}) + (-0.02415 \text{ Mental accounting 2}) + (-0.02573 \text{ Myopia 1}) + (-0.01430 \text{ Myopia 2}) + (-0.02578 \text{ Anchoring effect}) \quad (2)$$

The P-value of the F-statistic equals 5.6E-145, the H_0 hypothesis is rejected, the model as a whole is statistically significant. The value of the determination coefficient is 85.22%. Compared to Model 1, this value is higher, and so we can say that Model 2 has a better predictive power than Model 1. Similarly, the value of the adjusted determination coefficient has risen to 84.74%. In Model 2 we have one statistically insignificant variable,

so we have compiled a third model in which we have omitted this statistically insignificant variable, we call it Model 3. All p-values of the coefficients were lower than the significance level $\alpha = 0.05$, which means that we reject the H_0 hypothesis and all the variables are statistically significant. The sign of variables that represent deviations from rationality is again negative, that is, the indirect dependence between ROA and deviations from rationality. The sign of the variable age is positive, and therefore it is the direct dependence of the ROA variable and the variable age. Model 3 takes the form:

$$y_i = 0.13177 + 0.00356 \text{ Age} + (-0.02523 \text{ Overconfidence bias}) + (-0.02750 \text{ Aversion to loss}) + (-0.02240 \text{ Aversion to loss and willingness to risk}) + (-0.01995 \text{ Availability}) + (-0.02722 \text{ Overestimate of low probabilities}) + (-0.02055 \text{ Mental accounting 1}) + (-0.02407 \text{ Mental accounting 2}) + (-0.02569 \text{ Myopia 1}) + (-0.01431 \text{ Myopia 2}) + (-0.02574 \text{ Anchoring effect}) \quad (3)$$

For Model 3, the p-value of the F-statistic was $3.9E-146$, which means that we reject the H_0 hypothesis and the model as a whole is statistically significant.

The determination factor of R^2 is 85.22% for Model 3, which is the highest value of this indicator so far. Similarly, the value of the adjusted determinant increased to 84.78%. We can say that Model 3 is the best designed and most powerful of the models.

In the second case, we will build models where the ROE indicator is the dependent variable. This indicator is not as complex as ROA, so we expect the results will differ. First, we constructed a model called Model 4. In this model, we examined the impact of the deviations from rationality on the financial performance of a business, measured through the ROE. All ten deviations enter the model. In this case, we have variables that are statistically insignificant. It is a variable of aversion to loss, mental accountancy 1, shortsightedness 2. Variable mental accountancy 2 has a boundary p-value, which means that at the level $\alpha = 0.05$ we would also consider it statistically insignificant. The sign before the coefficients is again negative, even in this case it is an indirect dependence, and therefore with the increasing deviations, the value of the ROE indicator will decrease. The model as a whole, despite the insignificant parameter, can be evaluated as statistically significant as the p-value of the test F-statistic is $1E-57$. H_0 hypothesis is rejected. Model 4 has the form:

$$y_i = 0.63449 + (-0.10012 \text{ Overconfidence bias}) + (-0.02879 \text{ Aversion to loss}) + (-0.04685 \text{ Aversion to loss and willingness to risk}) + (-0.11064 \text{ Availability}) + (-0.07312 \text{ Overestimate of low probabilities}) + (-0.04005 \text{ Mental accounting 1}) + (-0.04284 \text{ Mental accounting 2}) + (-0.05804 \text{ Myopia 1}) + (-0.01176 \text{ Myopia 2}) + (-0.07045 \text{ Anchoring effect}) \quad (4)$$

The determination coefficient R^2 is 54.63% for this model, which is much less compared to models built on the ROA indicator. Even the adjusted determination coefficient R^2_{adj} has a low value compared to previous models, at only 53.41%. We can say that Model 1, which has the same independent variables but is constructed on the basis of the ROA indicator, has a better predictive power than Model 4.

As with the ROA indicator, we also constructed an ROE model in which, besides the deviations from rationality, we included variables for age and gender. This model is called Model 5. Even in this case, the model has statistically insignificant variables. These are the variables of aversion to loss, aversion to loss and willingness to risk, overestimation of small probabilities, mental accountancy 1, mental accountancy 2, myopia 1 and myopia 2. The P-value of these variables is higher than $\alpha = 0.05$ and we do not reject the zero hypothesis about the statistically insignificant variables. The sign on deviations from rationality is again negative, that is, indirect dependence. Direct dependence is on age and gender. Model 5 thus has the form:

$$y_i = 0.03623 + 0.01447 \text{ Age} + (-0.07914 \text{ Overconfidence bias}) + (-0.01139 \text{ Aversion to loss}) + (-0.02689 \text{ Aversion to loss and willingness to risk}) + (-0.07430 \text{ Availability}) + (-0.04206 \text{ Overestimate of low probabilities}) + (-0.00766 \text{ Mental accounting 1}) + (-0.02511 \text{ Mental accounting 2}) +$$

$$(-0.03165 \text{ Myopia 1}) + (-0.01408 \text{ Myopia 2}) + (-0.03316 \text{ Anchoring effect}) + 0.00667 \text{ Gender} \quad (5)$$

Despite the statistically insignificant variables in the model, the p-value of the test F-statistic is very low at 5,87E-60, and thus we reject the null hypothesis and the model as a whole is statistically significant. The value of the determination coefficient in this case is 55.85%, which is higher than in Model 4, but is still smaller than in the previous models. Even the adjusted coefficient value is low, namely 55.39%. Even so we can say that Model 2, which has the same independent variables, has better explanatory power than Model 5. If there are statistically insignificant variables in the model, the professional literature recommends that one deletes such variables, beginning with the least significant, and re-estimating at each stage. This procedure leads to Model 6, which has only four variables: age, overconfidence bias, availability and anchoring effect. Model 6 has the form:

$$y_i = 0.25386 + 0.01900 \text{ Age} + (-0.09263 \text{ Overconfidence bias}) + (-0.07966 \text{ Availability}) + (-0.03979 \text{ Anchoring effect}) \quad (6)$$

Dependence is again indirect in deviations from rationality; in the age it is a direct dependence. The model as a whole is also evaluated as statistically significant. The P-value of F-statistic is 1.22E-65, so we reject the null hypothesis about the non-importance of the model as a whole. The value of the determination coefficient is 56.82%, which is higher than the previous values, but is still lower than in the models we used for the ROA indicator. The same is true for the adjusted coefficient of determination, which is 55.42%.

4 Conclusions

After designing all the models and evaluating them, we can conclude that psychological aspects have an impact on the performance of the business. As we have seen, there were statistically significant variables in each model that represented deviations from rationality. Psychological aspects affect company performance measured through ROA and ROE.

In addition, entrepreneurs as investors are influenced by financial factors other than rational expectations and the assumption of an efficient market. This has been confirmed in the design of linear regression models.

We can also say that there is an indirect dependence between the investor's financial decision-making measured by ROA, ROE, and cognitive deviations from rationality. We can confirm this hypothesis on the basis of coefficient markers in each model that clearly demonstrated the indirect dependence between deviations from rationality and the financial performance of the business, measured through ROA and ROE.

Monitoring deviations from rationality and linking them to companies' financial performance is not widely studied. Indeed, our research is unique. Until now all behavioral finance research has focused only on individual investor behavior.

Traditionally oriented economists question the methods used in behavioral economics, especially experiments and tests. They point to the fact that people often say one thing but do another. However, if experiments and tests are performed professionally, their results are comparable in different situations and environments (Baláž, 2006).

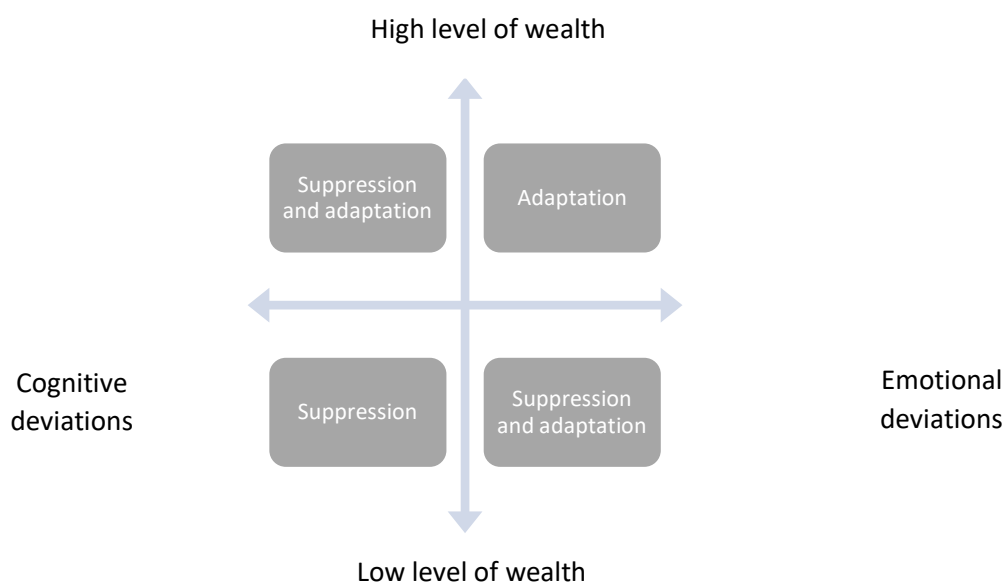
Richard Thaler sampled several thousand volunteers and found that patterns of behaviour are determined by mental abbreviations, resulting in systematic and predictable mistakes (Thaler, 2008).

Kahneman and Tversky (1984) have been able to systematically question the traditional theory of rational theory in their numerous experiments.

Behavioral economics provides us with a number of practical results that can be used to better understand behavior. By recognizing its radical findings people can correct mistakes and achieve greater value in their decisions. As the scope of behavioural economics expands and more anomalies are explained, more people will become aware of its implications and their decision-making will improve.

Asked whether the financial adviser should try to suppress or deviate from traditional rationality, Pompian (2006) based his answer on two key factors. The first is the wealth of the investor. According to the author, the advisor should adjust to the deviations of richer investors but try to suppress deviations by investors with only small assets. The logic of this advice is that while deviations from traditional rationality may threaten a client's standard of living, the impact is relatively less important the richer the client. The second factor is the nature of the deviations from rationality. If cognitive deviations predominate, the advisor should try to suppress them as the explanation and the provision of comprehensive information can minimize investor cognitive deviations. On the other hand, emotional deviations are mostly related to the nature and impulsivity of the investor and are very difficult to influence. Scheme 1 below illustrates the principles of adapting or suppressing deviations.

Figure 1 Illustration of Adaptation or Suppression of Deviations



Source: Own processing, following Pompian, 2006

References

- Baláž, V. (2006). *Rozum a cit na finančných trhoch*. Bratislava: VEDA.
- Kahneman, D., Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, vol. 47(2), pp. 263-292.
- Kahneman, D., Tversky, A. (1984). Choice, values and frames. *The American Psychologist*, vol. 39(4), pp. 341-350.
- Pilch, C. (2014). Seriál: Odchýlky od racionality pri investovaní. 2. časť – Niektoré vybrané odchýlky. *FOR FIN Odborný mesačník pre financie a investovanie*, vol. 1(6), pp. 1-7.
- Pilch, C. (2014a). Seriál: Odchýlky od racionality pri investovaní. 6. časť. *FOR FIN Odborný mesačník pre financie a investovanie*, vol. 1(11), pp. 1-7.
- Pompian, M. (2006). *Behavioral Finance and Wealth Management*. New Jersey: John Wiley & Sons.
- Thaler, R. (2008). Mental accounting and consumer choice. *Marketing Science*, vol. 27(1), pp. 15-25.

Using of Non-financial Data in Predictive Models

Zuzana Kubaščíková¹, Miloš Tumpach², Zuzana Juhászová³

¹ University of Economics in Bratislava
Faculty of Business Informatics, Department of Accounting and Auditing
Dolnozemska 1, 852 35 Bratislava, Slovakia
E-mail: zuzana.kubascikova@euba.sk

² University of Economics in Bratislava
Faculty of Business Informatics, Department of Accounting and Auditing
Dolnozemska 1, 852 35 Bratislava, Slovakia
E-mail: milos.tumpach@euba.sk

³ University of Economics in Bratislava
Faculty of Business Informatics, Department of Accounting and Auditing
Dolnozemska 1, 852 35 Bratislava, Slovakia
E-mail: zuzana.juhaszova@euba.sk

Abstract: *Forecasting the company's future economic situation arose in the early 20th century. First of all, a multidimensional discriminatory analysis was used to construct prediction models, later replaced by logistic regression. The new challenge in predicting financial development is neural networks representing a more reliable financial forecast compared to mathematical and statistical methods. The neural network, by mimicking the capabilities of human brain neurons, is capable of modeling the course of dependencies between individual indicators and results. A disadvantage of the original prediction models is also the low range of empirical accounting data and the fact that they are focused only on financial data. The introduction of the financial statements registers led to the possibility of free access to full data from the financial statements, which opens the door to new possibilities in scientific research. For the purpose of this paper an annual report of 20 selected companies were tested. The aim of this paper is to accept or reject the claims that non-financial „narrative” data could be also used for the assessment of the financial position and financial performance of the companies. The results of our sentiment analysis supported the hypothesis that financially distressed companies use a different tone of language in their annual reports compared to financially stable companies. These findings confirmed the relationship between the tone which managers use in constructing annual report narratives, and the financial performance of the company. Therefore, it is advisable to incorporate non-financial data into the forecasting models.*

Keywords: *financial statements, financial analysis, neural network, deep learning, data mining*

JEL codes: M49

1 Introduction

The goal of financial analysis is to recognize what is bad and good for the business, which can cause problems in the future, and vice versa, to identify its strengths that can be relied upon in the future (Šlosárová, 2014). The forecasting of the financial situation of enterprises is considered to be a relatively young area of scientific research, which dates back to the 30s of the 20th century. At the beginning experts predicted the future financial situation by comparing financial ratios. Beaver (1966) examined the financial indicators on the basis of a one-dimensional discriminatory analysis. There are known following prediction models - Altman (1968), Deakin (1972), Ohlson (1980), Taffler (1982) or Zmijewski (1984).

At the end of the 1960s, multidimensional discriminatory analysis began to be used for forecasting. Based on the multidimensional discriminatory analysis, it was the first model of the Altman (1968) predictive model for publicly-traded joint stock companies (the so-called Model Z-score) which some other theoreticians and practitioners have already been

taking in the short time, Deakin (1972) and Blum (1974). In the 1980s, logistical regression was gradually brought to the forefront of financial forecasting research, which gradually replaced multidimensional discriminatory analysis. First, he used logistic regression to create a model to predict the future financial situation of Ohlson (1980).

Prognosis of the future situation of a business entity through methods of multidimensional discriminatory analysis and logistic regression is very widely used, but in reality, when predicting company failures, these methods have certain limitations that largely result from their very nature. One of the basic assumptions of multidimensional discriminatory analysis and logistic regression is dichotomic dependent variability. What requires groups of companies with a good financial situation and an unsatisfactory financial situation to be clearly defined and clearly distinguishable. In practice, however, this assumption is very difficult. The problem is the very definition of defaulting companies, from which the classification of the companies on which the prediction model is based depends. Most models use a sample composed of two priority groups "unsuccessful" and "successful" companies. Models constructed on the basis of multidimensional discriminatory analysis and logistic regression have limitations that relations between financial ratios are unstable over time and, due to changes in inflation, economic cycles in a given country, interest rates. instability over time leads to a change in the set coefficients of the ratios or changes in the boundary classification values. The disadvantage of these approaches is also the low scope of empirical accounting data, moral wear and tear in countries where these analyzes were directly related and further low usability in the conditions of the Slovak Republic, as they use data which have a low prediction ability in the Slovak environment or some data are not available at all (for example, market price of shares). These facts should lead to regular testing of the model and its re-verification, if necessary.

One of the first studies dealing with the comparison of neural networks (NN) with classical mathematical and statistical techniques in forecasting the financial development of enterprises was the Odom and Sharda study of 1990. Neural networks represent one of the areas of machine learning. By machine learning, we mean a set of methods and approaches that allow the machine to learn. The system's knowledge gains from the training set of data. This system (in our case the neural network) should also have the ability to generalize.

In 2015, Blanco-Oliver published a collection of study authors focusing on creating a model for micro-accounting units. They introduced non-financial information into the model and constructed it using neural networks. In this study, we conclude that predicting bankruptcy through neural networks can achieve greater predictive power and lower cost of classification errors than with logistic regression and the introduction of non-financial variables improves the predictive precision of models. According to this study, the introduction of neural network access and the introduction of non-financial variables are two important means to improve the predictive precision of predictive models (Blanco-Oliver, Irimia-Díez, Oliver-Alfonso, Wilson, 2015).

A very large number of published studies to compare classical mathematical and statistical methods with neural networks confirm the conclusion that neural networks are better suited to predicting bankruptcy and have significantly higher predictive precision than logistic regression or multidimensional discriminatory analysis. The introduction of non-financial or macroeconomic variables into the model through independent indicators greatly improves the predictive precision of the model and the use of any method to model. It is not necessary to note that questions about modeling through neural networks such as the integration of data mining methods, the selection of suitable parameters, the selection of functions, a wide range of different techniques, etc., which are currently not universally and sufficiently relevant, are still open based on previous research, and should therefore do research in the future to answer these questions.

Machine learning is widely used nowadays to review contracts, leases, invoices, and other documents. The adoption of machine learning within the accounting profession is still, admittedly, at an early stage. To accelerate the wider use of this technology, it is necessary to create economies of scale by integrating its cognitive capabilities in the areas of textual

analysis, voice recognition, image and video parsing, and judgment support into the financial analysis and audit process. This article discusses how the cognitive capabilities of machine learning of non-financial data from annual reports could be applied to financial analysis and predictive models and to enable improve decision making.

2 Methodology and Data

For the purpose of this paper we analyzed annual reports of companies divided into two groups based on Altman's bankruptcy prediction model: financially distressed companies likely to go bankrupt within the following two years and financially stable companies with the high probability to survive. This model proposed bankruptcy based on financial ratios based on current financial results. We examined whether the qualitative information contained in annual report narratives indicated the bankruptcy alongside this quantitative information. Thus, we analyzed whether companies likely to go bankrupt employed a different tone of language compared to financially stable companies.

For this purpose, we selected 20 companies out of the Fortune 1000 list (Fortune, 2018). We divided them into two equal groups according to Altman's Z-score obtained from the Factiva database portal. Further, in order to obtain the data, we collected annual reports, 10-K filings, of U.S. companies from the EDGAR database (EDGAR, 2018). In total, we examined 20 annual reports for the fiscal year 2016.

Table 1: Companies Classified into the "Distress Zone" According to Altman's Z-score

Rank	Company	Z-score	Industry (SIC)
1.	Anadarko Petroleum Corp.	0,71	Crude Petroleum and Natural Gas
2.	Apache Corp.	0,55	Crude Petroleum and Natural Gas
3.	Caesars Entertainment Corp.	-0,24	Hotels and Motels
4.	Darling Ingredients	1,53	Animal and Marine Fats and Oils
5.	Freeport-McMoRan, Inc.	0,22	Copper Ores
6.	Leucadia National Corp.	0,46	Investors, NEC
7.	Post Holdings, Inc.	1,06	Cereal Breakfast Foods
8.	The ADT Corp.	0,99	Security Systems Services
9.	WestRock Co.	1,35	Die-Cut Paper and Paperboard and Dardboard
10.	Windstream Holdings, Inc.	0,62	Telephone Communications

Source: Factiva Companies and Executives, 2018

The following table lists the "safe zone" companies, the industries in which they operate, and their Altman's Z-score:

Table 2: Companies Classified into the "Safe Zone" According to Altman's Z score

Rank	Company	Z-score	Industry (SIC)
1.	Applied Materials, Inc.	4,17	Semiconductors and Related Devices
2.	Campbell Soup	3,19	Canned Specialties
3.	Cisco Systems	3,14	Telephone and Telegraph
4.	Citrix Systems, Inc.	3,83	Pre-packaged Software
5.	Exxon Mobil	3,72	Petroleum Refining
6.	Johnson & Johnson	5,09	Pharmaceutical Preparation
7.	McDonalds Corp.	5,25	Eating and Drinking Places
8.	PepsiCo, Inc.	4,01	Bottled and Canned Soft Drinks
9.	Phillips 66	3,56	Petroleum Refining
10.	The Walt Disney Co.	4,5	Motion Picture and Video Production

Source: Factiva Companies and Executives, 2018

Although the companies were selected across various industries, we attempted to choose similar industries within both the safe zone and distress zone. This would help us to prevent the situation where industry-specific attributes would undermine the results as some words are more characteristic for some industries than others. Thus, the companies within both groups operated in telephone communication, the food sector, entertainment, petroleum refining, and security systems and software.

To assess the sentiment used in annual report narratives, we processed and analyzed this data with the LIWC2015 (Linguistic Inquiry and Word Count) textual analysis program. This program analyses text on various sentiment categories, including positive emotions, negative emotions, certainty, risk focus and others.

Linguistic Inquiry and Word Count (LIWC) is a text analysis computer program that provides output in the form of a percentage of the words contained in the text from the categories mentioned. For example, if the text contains 1,000 words, the dictionary might find 50 words which occur in the text express positive emotion, so then it allocates score 5 to positive sentiment. Thus, within each category the score ranking from 0 to 100 may be attributed to the specific text. The more words the software analyses, the more reliable the results are. As our samples contained texts ranging from 7,000 to 22,000 words, we consider the results obtained to be reliable (LIWC, 2018).

We employed this computer-assisted dictionary in order to analyze the sentiment aspect of annual report. Each of the companies was, firstly, analyzed individually on several categories of sentiment. Then we synthesized the results obtained for "distress zone" companies and "safe zone" companies in order to get the full picture about the differences between these two.

3 Results and Discussion

Although the idea of artificial neural networks dates back to the 1950s, such networks could not be called real artificial intelligence until recent advances in computational power and data storage enabled the development of deep neural networks that model the structure and thinking process of the brain. The hidden layers of a deep neural network automatically "learn" from massive amounts of data (especially semi-structured or unstructured data) received by the input layer (e.g., also images, annual reports, text files), recognize data patterns in more and more abstract representations as the data is processed and transmitted from one hidden layer to the next, and classify the data into predefined categories in the output layer.

Deep learning algorithms further enrich financial analysis by identifying related concepts or topics, recognizing entities (e.g., people, place, events, companies), extracting emotions (e.g., anger, joy, sadness, disgust), and understanding subject-action-object relationships. In addition, they can link concepts to a document and tag them accordingly. Deep learning technology—an emerging form of artificial intelligence that can be trained to recognize patterns in vast volumes of data that would be impossible for humans to process. This still evolving technology represents a way to utilize big data to create supplementary audit evidence that improves the effectiveness and efficiency of audit automation and decision making.

For example, financial analysts can select data attributes in order to predict bankrupt (auditors can predict fraud); the selected attributes are then combined with traditional financial or nonfinancial data fields to develop a new deep learning prediction model. Deep learning performs as an appropriate prediction algorithm in this case because, by introducing the extracted attributes, the number of predictors is much larger than what a traditional machine-learning algorithm could process. For each assertion, the output of the model could be the predicted risk level or suggested follow-up tests, depending upon the nature and the label of the training data.

For the purpose of this paper, we analyzed the companies according to the Altman Z-score to find out whether the qualitative information expressed in narrative reporting differs between companies with a high probability of bankruptcy and those in a financially stable

position. Thus, we could assume that the annual report narratives of financially distressed companies show sentiment which is more negative and more uncertain compared to the financially healthy companies.

We found out that financially healthy companies achieved a slightly higher score on positive sentiment compared to distressed companies (2,79 vs. 2,77). When we examined more deeply the companies themselves, we found that companies from the distressed group which had suffered a loss in fiscal year 2015 employed less positive and more negative emotions than the distress- classified companies which, however, achieved a profit.

However, when we further examined the negative emotion elements, we could see that companies with probable financial problems tended to employ more anxious language compared to the other group (0,26 vs. 0,21). This may be due to the fact that distressed companies are worried about the future because even though they might not fall into financial problems yet, it is likely that they will experience them within the next two years. Thus, they expressed their concerns through this category of words even before the bankruptcy or insolvency appears. However, when we considered only the companies which already suffered a loss in fiscal year 2015 from the distressed group, these have a much lower level of anxiety compared to the rest of the group (0,20 vs. 0,30) and a slightly higher level of certainty (0,79 vs. 0,76).

Interestingly, the financially distressed companies ranked lower on two almost opposing categories: certainty (0,77 vs. 0,84 achieved by the safe group) and tentativeness (1,79 vs. 1,94 achieved by the safe group). Even though these results are relatively surprising, distressed companies with a poorer financial performance were found to be more certain and, at the same time, more uncertain compared to the better-performing companies. It might be caused by the fact that these companies, on the one hand, connect uncertain terms with the financial situation and, on the other hand, the certain terms with activities to handle the poor financial situation. Therefore, in our case, we could use the reasoning that financially distressed firms are less tentative in terms of handling their financial situation, for example, implementing new strategies, restructuring programs, and other initiatives in order to prevent the possible bankruptcy. However, they are still more uncertain referring to their future financial situation compared to companies from the safe zone which can be almost sure they will not experience bankruptcy during future years.

Then the five additional categories were examined. Those are Affiliation, Achievement, Power, Reward focus, and Risk focus. All of them belong to LIWC2015 categorization. They could provide important clues about what specifically drives company performance and/or which categories the managers would like to place the highest emphasis on in their reporting while assessing company financial performance and future trends.

Companies within the safe zone achieve a higher score on the first four categories - affiliation (2,6 vs. 2,5), achievement (1,8 vs. 1,65), power (2,74 vs. 2,69), reward (1 vs. 0,65). The financially distressed companies only outperform them on the risk category (0,96 vs. 1,09). The power category, on which both groups score the highest (2,74 and 2,69) reveals interest in status and dominance. However, this category is likely to comprise words like "boss", "president", or "strong". Thus, it is obvious that such words appear in the annual reports of the companies. Therefore, this category does not have a huge explanatory power for the purpose of our analysis.

What is, however, more interesting is the fact that financially distressed companies already see the higher risk connected with their financial performance, and we can see that this is reflected in the texts of their narratives. Therefore, this analysis might help us to predict the financial performance of the firms to some extent. The full picture which combines the insight into all of these five categories together could, therefore, provide us with some evidence about the worsening financial performance of a company expressed in the textual part of the annual reports.

4 Conclusions

The financial data comprised in annual reports are important indicators of current financial performance and may also indicate future financial development via the application of prediction models such as Altman's Z-score. However, they do not provide us with insight into all of the circumstances that led to these results, information about future trends, development and managers' expectations. For this purpose, the qualitative data is especially useful.

For the purpose of this paper the annual reports of 20 selected companies were tested. Companies were randomly selected from database Fortune 1000. Their Altman Z-score was obtained from the Factiva database. We have chosen companies across various industries. Firstly, we focused on the tone used by managers when discussing company performance, position and future trends in annual reports. For this purpose, was used computerized text analysis program.

Although annual report narratives are more subjective compared to the financial data, we suggest they may be indicative of future financial developments, as demonstrated by the language managers use to disclose information. In this study we used a textual analysis software in order to accept or reject the claims, that non-financial "narrative" data could also be used for the assessment of the financial position and financial performance of a company. Our analysis focused on the Management Discussion and Analysis section (MD&A) of the 10-K reports. Here managers comment on financial performance, but also express predictive statements about future trends, expectations and challenges. Therefore, the information comprised in these sections indicate future financial performance.

The results of our sentiment analysis supported the hypothesis that financially distressed companies use a different tone of language in their annual reports compared to financially stable companies. These findings confirmed the relationship between the tone which managers use in constructing annual report narratives, and the financial performance of the company. Therefore, it is advisable to incorporate non-financial data into the forecasting models. This can be incorporated into prediction models based on neural networks.

However, the research presented has its limitations that could subsequently affect the reliability and accuracy of the results achieved and on which our recommendations are based it can be possible to eliminate the drawbacks by using neural networks but this requires a bigger data sample and automated input data processing.

Acknowledgments

This article is an output of the project of the Scientific Grant Agency of the Ministry of Culture of the Slovak Republic and Slovak Academy of Sciences (VEGA) no. 1/0512/16 (2016-2018) "Retention and Development of Business Property of Company as a Relevant Tool for Sustainable Development."

References

- Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *Journal of Finance*, vol. 23(4), pp. 589-609.
- Blanco-Oliver, A., Irimia-Diequez, A., Oliver-Alfonso, M., Wilson, N. (2015). Improving Bankruptcy Prediction in Micro-Entities by Using Nonlinear Effects and Non-Financial Variables. *Finance a Uver: Czech Journal of Economics & Finance 2015*, vol. 65(2), pp. 144-166.
- Deakin, E. (1972). A discriminant analysis of predictors of business failure. *Journal of Accounting Research*, vol. 10, pp. 167- 179.
- Edgar (2018). *Edgar Company Filings*. Retrieved from: <https://www.sec.gov/edgar/searchedgar/companysearch.html>.

Factiva (2018). *Factiva: Get Company Snapshot*. Retrieved from: <https://global-factiva-com.scd-rproxy.u-strasbg.fr/sb/default.aspx?Inep=hp>.

Fortune (2018). *Fortune 500*. Retrieved from: <http://fortune.com/fortune500/>.

LIWC (2018). *How does LIWC analyse language?* Retrieved from: <http://liwc.wpengine.com/how-it-works/>.

Odom, M. D., Sharda R. (1990). A neural network model for bankruptcy prediction. In: *Proceedings from IJCNN International Joint Conference Neural Networks*. pp. 163-168. Retrieved from: https://www.researchgate.net/publication/224755073_A_Neural_Network_Model_for_Bankruptcy_Prediction

Ohlson, J. A. (1980). Financial ratios and probabilistic prediction of bankruptcy. *Journal of Accounting Research*, vol. 18(1), pp. 109-131.

Ondrušová, L. (2016). Company in crisis form the point of view of accounting. *Journal of East European Science and Research: scientific peer-reviewed journal*, vol. 8(1), pp. 338-345.

Šlosárová, A. (2014). *Analýza účtovnej závierky*. Bratislava: Ekonóm.

Taffler, R. J. (1982). The Z-score approach to measuring company solvency. *The Accountant's Magazine*, pp. 22-24.

Zmijewski, M. E. (1984). Methodological issues related to the estimation of financial distress prediction models. *Journal of Accounting Research*, vol. 22, pp. 59-82.

The Role of Apparent Signs of Financial Distress in Test Samples and Verification Samples of Bankrupt Models

Michal Kuběnka, Renáta Myšková, Josef Novotný, Vít Jedlička

University of Pardubice
Faculty of Economics and Administration, Institute of Business Economics and Management
Studentská 84, 532 10, Czech Republic
E-mail: michal.kubenka@upce.cz; renata.myskova@upce.cz; josef.novotny@upce.cz;
vit.jedlicka@student.upce.cz

Abstract: Financial bankrupt models are characterized as quite accurate and above all very fast tools for quantitative evaluation of financial health of company. The creators report the accuracy of the predicted bankruptcy usually in the range of 70 to 90%. But the problem of bankruptcy models is the test sample on which the models were created. The sample affects the predictive power of these models. Usually indicated accuracy rate differs from the real predictive power of these models. The financial distress of certain businesses may be obvious even without the use of bankruptcy models. Apparent signs of financial distress may be insolvency, negative equity, VAT unreliability, negative economic result for several years in a row. Survey conducted by more than 270 companies has shown that more businesses with apparent signs of financial distress in the sample increase the reported accuracy of the bankruptcy model. The research carried out also has determined the real accuracy of selected bankruptcy models on the standard sample of Czech firms and also on a sample of companies where companies with obvious signs of financial distress were eliminated. Due to the modification of the test sample subsequently the accuracy of the selected models changed radically.

Keywords: bankrupt models, financial distress, prediction

JEL codes: G32, M10, C38

1 Introduction

The legislation on insolvency proceedings in the Czech Republic is contained in Act no. 182/2006 Coll., "On Bankruptcy and Methods of its Settlement", as amended (hereinafter the Insolvency Act). This Act entered into force on 1st January 2008 and replaced the previous regulation contained in Act no. 328/1991 Coll. The position of insolvency administrators in charge of this issue is regulated by Act no. 312/2006 Coll. on Insolvency Administrators, as amended. According to the Insolvency Act, it is possible to solve not only if financial failure has already occurred but also the imminent bankruptcy. Insolvency act (§3) defines the concept of bankruptcy with three conceptual features - plurality of creditors, the existence of repayable obligations for more than 30 days and the inability to perform financial obligations.

Table 1 Insolvency Proposals in the Czech Republic in 2010-2017

Year	Corporates	Individuals	Total
2010	5559	10559	16118
2011	6753	17600	24363
2012	8398	23830	32228
2013	6021	30888	36909
2014	3563	31577	35140
2015	3004	29349	32353
2016	2438	27067	29505
2017	1803	21343	23146

Source: CreditReform 2012, 2015, 2017

Table 1 shows that insolvency proposals are tens of thousands each year. Therefore, it is important to prevent a situation where this situation occurs in one's own business or

business partner. Timely disclosure of incoming bankruptcy may cause avoidance of bankruptcy or minimize losses as a result of the bankruptcy of a business partner.

Bankruptcy models are based on the assumption that an enterprise has been showing signs of bankruptcy for years and years before it has gone bankrupt. A prediction of financial bankruptcy in advance could thus avert an imminent bankruptcy. Attempts to find a simple and yet accurate model that would be able to classify future financial decline appears in the middle of the last century. The break was 1968, when prof. Altman (Altman, 1968) created a bankruptcy model Z score using multivariate analysis. This model is based on financial data contained in account books. Therefore, the input data is easily accessible and subsequent enterprise application is possible for the general public. His model works with five financial ratios. Relatively soon it was followed by other specialists, who also used other mathematical and statistical methods. For instance, for creation of his bankruptcy model J. A. Ohlson used the logit linear probability in 1980 as the first one (Ohlson, 1980). In the year 1985 the factor analysis was used in order to get independent variables for the logit model (Zavgren, 1985). Later the progress has led to methods of artificial intelligence that mainly use the neural networks (NN) for creation of prediction models since nineties of last century. Tam and Kiang (Tam, 1991), (Tam & Kiang, 1992) belong to pioneers of NN usage. Particular methods (MDA vs. Logit vs. NN) of models creation were compared many times. The results show NN as the most suitable method as proven by (Pendharkar, 2005) (Liang, 2005) (Rafiei, Manzari and Bostanian, 2011). After the passage to the market economy (nineties 20th century) the bankrupt models also started to origin in the Czech Republic and Slovak Republic in order to predict the company bankruptcy. These models should regard the market specificity of these countries. The model (index) IN95 (Neumaierová & Neumaier, 2002) has appeared as the first one, being designed as the creditor's model, as it is mostly used for subjects in the creditor's position (banks and business partners). In 1999 the same authors brought the so-called ownership's model, named IN99. Its function consists in the prosperity prediction based on the positive economic value added (EVA). In 2001 they created the model IN01 that connected properties of both previous models, i.e. it predicts the bankruptcy as well as the prosperity. Just in the year 2005 it was updated to the version called index IN05 (Neumaierová, 2005). There is a lot of models for earnings prediction (e.g. Hou & Van Dijk & Zhang, 2012; Sheng & Thevenot, 2012; Duspiva & Novotný, 2012; Banker & Chen, 2006) but only IN05 predicts EVA. Before the economic crisis two models focused on the agriculture appeared in Slovakia. It was CH-index from 1998 (Chrastinová, 1998) and G-index from 2002 (Gurčík, 2002). After the economic crisis in 2008 only few bankruptcy models appeared at the territory of the Czech Republic and the Slovak Republic, i.e. P' model (Delina & Packová, 2013) and the bankruptcy Index of Karas and Režňáková (I_{KR}) (Karas & Režňáková, 2013). Čámská emphasizes that the application of these types of model is „user friendly as they do not require any specific mathematic and statistic knowledge of the user“ (Čámská, 2013). The authors of model I_{KR} determine the model accuracy 91.71% (calculated as the weighted average of sensitivity and specificity). The authors of model P' determine the bankruptcy prediction accuracy 21.26% and the bankruptcy prediction return at 71.84%.

Kuběnka and Slaviček (Kuběnka and Slaviček, 2014) claim that although prosperity and bankrupt models were created differently, their construction is similar, which means a combination of ratios and assigned weights of importance. Financial diagnostic and prediction models vary predominantly in their targeting. However, despite a long history of these models there are still used groups of simple ratios for economic and financial stability analysis, e.g. (International Monetary Fund; Černohorská & Linhartová, 2013).

Let's suppose that the bankruptcy model is accurate at maximum when applied in the region (country) of its origin (due to the differences of accounting methods (see more Honková, 2015), market environment, etc.). Let's also suppose that the market environment in the Czech Republic and the Slovak Republic is still very close. Thus we shall test just last two mentioned models (I_{KR} and P' model) in order to define their accuracy on sample of companies with and also without of apparent signs of financial distress. Altman's Z score models are the most famous in the world. That is why one of them is also tested.

The goal of this survey is to answer the question whether a sampling pattern on which the accuracy of the model is validated by its structure does not affect the resulting accuracy of the model. The investigation will determine how far the specified accuracy of the models changes after eliminating the obvious bankruptcy features.

2 Tested models

The original **Altman Z-Score** of 1968 was designed for publicly traded joint stock companies. On the other hand, the Z'score (1983), which was published in 1983, was compiled for public limited companies and non-publicly traded shares. Below is a modification of the previous model where the X_4 indicator has been altered from the market value of the equity to the book value of the equity. The stated accuracy of this model is 82% (18% error of type I.). The model has the following form (Altman, 1993):

$$Z' = 0,717 \cdot X_1 + 0,847 \cdot X_2 + 3,107 \cdot X_3 + 0,420 \cdot X_4 + 0,998 \cdot X_5 \quad (1)$$

where:

- X_1 = working capital / total assets;
- X_2 = retained earnings / total assets;
- X_3 = earnings before interest and tax / total assets;
- X_4 = book value of equity / total assets;
- X_5 = sales / total assets.

Creditworthy enterprises should have a score of more than 2.90, and on the other hand enterprises in default below 1.23. The results between boundary values (1.23; 2.90) cannot be clearly explained.

Index of Karas and Režňáková (I_{KR}) is one of the newest bankruptcy model with different structure of variables calculation. All known bankruptcy models (based on author's knowledge) use 4 ratio indexes at minimum, whereas I_{KR} use only two of them. The first one (X_2) is the assets turnover and the second one (X_3) is the ratio of quick assets and sales. In addition, it contains the variable of absolute amount (X_1) that represent the value of total assets in EUR. The authors of index (Karas & Režňáková, 2013) created the model based on the sample of 880 financially stable and 628 bankrupted companies. Data were drawn from the accounting statements from the period 2007 to 2012. All 1508 companies belonged to the processing industry, based on their business activity, (NACE rev. 2, section C: Manufacturing).

In their text the authors (Karas & Režňáková, 2013) state that the model construction is based on the connection of linear discrimination analysis and the Box-Cox transformation variables. The model is shown as follows:

$$I_{KR} = 1.841 \cdot \frac{(X_1 + 16783.91)^{0.02941} - 1}{0.02941} + 1.112 \cdot \frac{(X_2 + 1)^{-0.35627} - 1}{0.35627} + 13.55 \cdot \frac{(X_3 + 1.112)^{-2.97955}}{2.97955} - 17,319 \quad (2)$$

where:

- X_1 = value of total assets (EUR)
- X_2 = turnover of total assets
- X_3 = quick assets a sales ratio

The border limit was determined by the 0 value. Then the company with achieved value $I_{KR} > 0$ should be financially healthy and with $I_{KR} < 0$ business goes bankrupt.

Delina and Packová (2013) proposed their own bankruptcy model using the ration indexes used in analyses models (Z-score, Creditworthiness Index, IN05) and regression analysis. The so-called **P' model** has the following form:

$$P' \text{ model} = 2.86 - 0.0001278X_1 + 0.04851A_2 + 0.2136A_3 - 0.000071A_4 + 0.0001068B_1 - 0.0006116B_4 \quad (3)$$

where:

- X_1 = (financial assets – short-term liabilities) / (operating expenses – depreciations)

- A_2 = retained earnings / total assets
 A_3 = profit before interests and taxes / total assets
 A_4 = registered capital / (long-term + short-term liabilities)
 B_1 = cash flow / total liabilities
 B_4 = earnings before taxes / total operating revenue

The evaluation scale does not contain the interval of non-specified values of P' model. The critical limit for the company classification is at the value 2,856. When $P' < 2.856$ the company tends to bankrupt, when $P' \geq$ the company is financially healthy and the bankruptcy probability is very low.

3 Research sample description

I was found 273 companies with defined parameters. This sample was used for finding of current accuracy of selected tested model (test no. 1). The sample consist of the companies operating in the manufacturing industry, in bankruptcy, who had available financial statements both in the year of bankruptcy and in the previous year, in order to be able to monitor the possible occurring negative events even in previous years.

In general, the following may be considered as negative events: bankruptcy, execution, insolvency, claim, enforced execution, liquidation, extinction, negative equity, VAT unreliability or loss for several consecutive years. And the last one was one of the main indicators of bankruptcy, along with negative own equity and negative economic performance observed on the sample being tested.

Out of the original 273 companies, 135 companies were eliminated on the basis of the observed loss for several consecutive years, the negative equity and the negative economic result. For the rest of 138 companies selected bankruptcy models were applied, detected accuracy evaluated (test no. 2).

Table 2 Frequency of Occurrence of Negative Events

Negative events	Absol. frequency	Relat. frequency
Loss for several consecutive years	34	25%
Negative equity & negative economic result	41	30%
Negative economic result	63	47%
Negative equity	82	61%
Total	135	100%

Source: Own research

4 Results

Test no. 1 consisted of applying models to a whole sample of enterprises (273 pcs) in bankruptcy. P' model evaluated correctly as bankrupt 203 businesses, it is 74.36% of sample. This has become the most successful model in testing. Only 71.44% (28.56% type I. error) assigned creators accuracy of the bankruptcy prediction. Sample application without apparent signs reduced the model's accuracy by 6.59% to 67.77%.

Z' score evaluated 185 companies (67.77%) in bankrupt, which is less than the creator states (82.00%). The least successful was the I_{KR} model, where the authors report accuracy of 69.91% and test no. 1 indicates accuracy 62.27%, i.e. 170 enterprises classified as bankrupt. Rank in success of prediction in test no. 1 is as follows:

- P' model (74.36%)
- Z' score (67.77%)
- I_{KR} (62.27%)

The reliability interval π for these results can be, according to Pacáková (2003), determined as follows.

$$P\left(p - z_{1-\frac{\alpha}{2}} * \sqrt{\frac{p(1-p)}{n}} < \pi < p + z_{1-\frac{\alpha}{2}} * \sqrt{\frac{p(1-p)}{n}}\right) = 1 - \alpha \quad (4)$$

where:

- p – found current accuracy of models (74.36%, 67.77%, 62.27%)
- n – the size of the base π , means number of companies in sample,
- α – determined at the level of 5%,

Table 3 states original accuracy stated by author, current accuracy checked in test no. 1, confidence interval of current accuracy and accuracy without apparent signs checked in test no. 2.

Table 3 Accuracy With and Without Apparent Signs

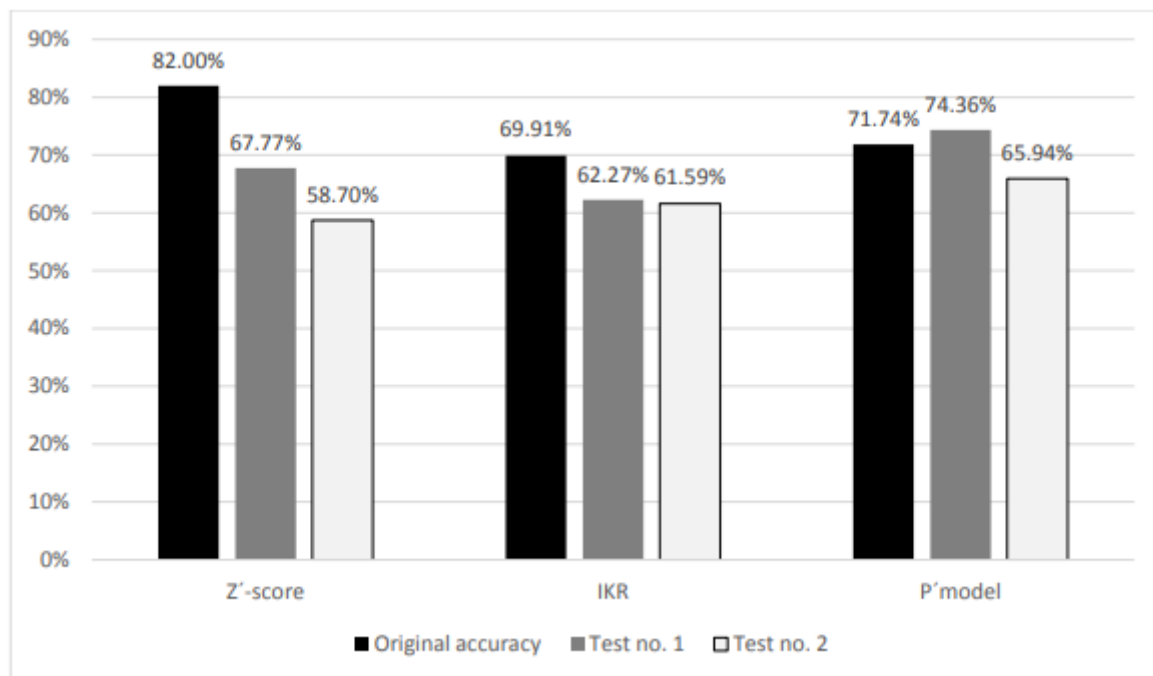
Model	Creator's accuracy	Current accuracy	Confidence interval	Without apparent signs
Z score	82.00%	67.77%	62.23; 73.31	58.70%
I_{KR}	69.91%	62.27%	56.52; 68.02	61.59%
P' model	71.84%	74.36%	69.18; 79.54	67.77%

Source: Own research

Accuracy without apparent signs was stated after reduction of research sample to 138 companies. As a result, the resulting order of accuracy will change as follows:

- P' model (67.77%)
- I_{KR} (61.59%)
- Z' score (58.70%)

Figure 1 Success of Business Failure Prediction



Source: own

Accuracy of Z' score and P' model in test no. 2 (without apparent signs) is out of confidence interval of accuracy checked in test no. 1. It means that usage of visible features of bankruptcy leads to distortions in the stated accuracy of the models. In case of Z' score and P' model it was confirmed with statistical significance. Success of prediction of IKR has also fallen specifically from 62.27% to 61.59% but without confirmation of statistical significance.

5 Conclusions

Every day many subjects need to evaluate in fast manner the financial health of business partners, loan applicants, debtors, etc. To this purpose there have been developed many failure prediction models. However their accuracy depends on many factors. On this basis authors have set themselves the task to answer the question whether a sampling pattern on which the accuracy of the model is validated by its structure does not affect the resulting accuracy of the model.

In order to meet this goal the classification of companies in 2009-2013 was confronted with the fact that these companies went bankrupt one year later.

I_{KR} model showed the worst prediction power in test no. 1, where was used a research sample of 273 companies. It correctly predicted a business failure in 62.27% of cases based on the data available a year earlier. Order accuracy has changed within the application to the reduced sample (without apparent signs) in test no. 2. Model moved from third to second place.

P' model was the best in bankruptcy predicting, namely in 74.36% of cases in test no. 1. In test no. 2 the accuracy fell down to 65.94%. This change is statistically significant. This model is the most successful also in test no. 2.

Z' score showed average accuracy in test one. This model has the worst results in test no. 2. From point of view of authors are more important the results of test no. 2 with the sample without of apparent signs.

The investigation has shown that the sample structure has a key impact on the reported accuracy of the bankruptcy model.

Acknowledgment

This contribution was made with the financial support of SGS_2018_013.

References

- Altman, E. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *Journal of Finance*, vol. 23(4), pp. 589 – 609.
- Altman, E. I. (1993). *Corporate Financial Distress and Bankruptcy: A Complete Guide to Predicting and Avoiding Distress and Profiting from Bankruptcy*. New York: John Wiley and Sons Inc.
- Banker, R., Chen, L. (2006). Predicting Earnings Using a Model Based on Cost Variability and Cost Stickiness. *The Accounting Review*, vol. 81(2), pp. 285-307.
- Berzkalne, I., Zelgalve, E. (2013). Bankruptcy Prediction Models: A Comparative Study of the Baltic Listed Companies. *Journal of Business Management*, vol. (7), pp. 72-82.
- Čámská, D. (2013). Czech Models Predicting Financial Distress from the User's Perspective. In: *Proceedings of Hradec Economic Days 2013*. Hradec Králové: Gaudeamus, pp. 125-131.
- Černohorská, L., Linhartová, V. (2013) The Impact of Corruption on Soundness of Banking Sector. In: *Proceedings of Finance and the Performance of Firms in Science, Education, and Practice*. pp. 199-208.
- CreditReform (2012, 2015, 2017). *Vývoj insolvenčí v české republice v roce 2012, 2015, 2017*. Retrieved from: <https://www.creditreform.cz/novinky-downloads/vyvoj-insolvenci-v-cr.html>.
- Delina, R., Packová, M. (2013). Prediction bankruptcy models validation in Slovak business environment. *E&M Economics and Management*, vol. 16(3), pp. 101-112.
- Duspiva, P., Novotný, J. (2012). Utilization of Quantitative Methods in the Decision Making Process of a Manager. *Scientific Papers*, vol. 17(2), pp. 63-69.

- Gurčík, L. (2002). G-index – the financial situation prognosis method of agricultural enterprises. *Zemědělská ekonomika*, vol. 48(8), pp. 373-378.
- Honková, I. (2015). International Financial Reporting Standards Applied in the Czech Republic. *E&M Economics and Management*, vol. 18(3), pp. 84-90.
- Hou, K., Van Dijk, M., Zhang, Y. (2012). The Implied Cost of Capital: A New Approach. *Journal of Accounting and Economics*, vol. 53(3), pp. 504-526.
- Huijuan, L. (2015). Default Prediction Model for SME's: Evidence from UK Market Using Financial Ratios. *International Journal of Business and Management*, vol. 10(2), pp. 81-106.
- Chrastinová, Z. (1998). *Metódy hodnotenia ekonomickej bonity a predikcie finančnej situácie poľnohospodárskych podnikov*. Bratislava: VÚEPP.
- International Monetary Fund (2015). *Financial Soundness Indicators and the IMF*. Retrieved from: <https://www.imf.org/external/np/sta/fsi/eng/fsi.htm>.
- Karas, M., Režňáková, M. (2014). Possibilities for the Application of a Bankruptcy Prediction Model for Measuring Credit Risk of a Company. In: *Proceedings of Hradec Economic Days 2013*. Hradec Králové: Gaudeamus, pp. 435-442.
- Kuběnka, M., Slaviček, O. (2014). Detection of Cognition between Creditworthy Models and Bankruptcy Models. In: *Proceedings of Managing and Modelling of Financial Risks*. Ostrava: VSB – Technical University of Ostrava, pp. 426-433.
- Liang, L., Wu, D. (2005). An application of pattern recognition on scoring Chinese corporations financial conditions based on backpropagation neural network. *Computers and Operation Research*, vol. 32(5), pp. 1115–1129.
- Neumaierová I., Neumaier I. (2002). *Výkonnost a tržní hodnota firmy*. Praha: Grada Publishing.
- Neumaierová, I. (2005). Index IN05. In: *Sborník příspěvků z mezinárodní vědecké konference Evropské finanční systémy 2005*. Brno: Masarykova universita, pp. 143-148.
- Ohlson, J. A. (1980). Financial ratios and probabilistic prediction of bankruptcy. *Journal of Accounting Research*, vol. 18(1), pp. 109–131.
- Pendharkar, P. C. (2005). A threshold varying artificial neural network approach for classification and its application to bankruptcy prediction problem. *Computers and Operations Research*, vol. 32(10), pp. 2561–2582.
- Rafiei, F. M., Manzari, S. M., Bostanian, S. (2011). Financial health prediction models using artificial neural networks, genetic algorithm and multivariate discriminant analysis: Iranian evidence. *Expert Systems with Applications*, vol. 38(8), pp. 10210–10217.
- Sheng, X., Thevenot, M. (2012). A New Measure of Earnings Forecast Uncertainty. *Journal of Accounting and Economics*, vol. 53(1–2), pp. 21-33.
- Tam, K. (1991). Neural network models and the prediction of bank bankruptcy. *Omega*, vol. 19(5), pp. 429–445.
- Tam, K., Kiang, M. (1992). Managerial applications of neural networks: the case of bank failure prediction. *Management Science*, vol. 38(7), pp. 926–947.
- Zavgren, C. V. (1985). Assessing the vulnerability to failure of American industrial firm: a logistic analysis. *Journal of Business Finance and Accounting*, vol. 12(1), pp. 19–45.

The Anti-Tax-Avoidance Measures in the EU – from Denials to Wide Acceptance

Jana Kubicová

University of Economics in Bratislava
Faculty of National Economy, Department of Finance
Dolnozemska cesta 1, 852 35 Bratislava, Slovak Republic
E-mail: jana.kubicova@euba.sk

Abstract: *In July 2016 the European Commission adopted the Anti-Tax Avoidance Directive (ATAD). The Directive lays down common harmonized rules of several kinds of anti-tax avoidance measures. Those rules are not brand new, in contrast, they have been well known for years in the national tax systems around the world. This paper presents survey of the former key decisions of the Court of Justice of the European Union concerning national exit taxation provisions and compares them to the current ATAD exit taxation provisions. The legal analysis suggests that several former Court of Justice of the EU decisions considerably differ from the adopted ATAD exit taxation rules. This shift might suggest that judgements of Court of Justice of the European Union and tax policy of the European Union institutions might not provide enough consistency and legal certainty. The paper hypothesizes four unspoken reasons which might lay behind introduction of the common harmonized exit taxation rules in the EU.*

Keywords: *tax avoidance, exit tax, Court of Justice of the European Union, harmonization*

JEL codes: *H26, K2, K34, K42, M21*

1 Introduction

In July 2016 there was adopted the *Directive laying down rules against tax avoidance practices that directly affect the functioning of the internal market* (EC, 2016) (hereinafter ATAD). The ATAD introduces common harmonized provisions of several anti-tax avoidance measures with aim to tackle and eliminate aggressive tax planning practices. Namely they are: limitations to the deductibility of interest, also known as thin capitalization rules, exit taxation, taxation of controlled foreign companies' rules, rules to tackle hybrid mismatches, and general anti-abuse rule (GAAR). Those rules are not brand new, in contrast, for years they have been integral part of the national tax systems around the world, especially in the most developed countries, including several "old" European Union Member States.

The Preamble of the ATAD lists several objectives of the ATAD, they are:

- to ensure that tax is paid where profits and value are generated;
- to restore trust and the fairness of tax systems and allow governments to effectively exercise their tax sovereignty;
- to find common yet flexible solutions at the EU level consistent with the OECD BEPS conclusions;
- effective and swift coordinated implementation of the anti-BEPS measures at the EU level;
- to ensure good functioning of the internal market;
- to discourage tax avoidance practices and ensure fair and effective taxation in the Union in a sufficiently coherent and coordinated fashion;
- to strengthen the average level of protection against aggressive tax planning in the internal market;
- to establish rules applicable to all taxpayers that are subject to corporate tax in EU Member States;
- to lay down rules against the erosion of tax bases in the internal market and the shifting of profits out of the internal market (EC, 2016).

For those who have been carefully watching development of international income taxation rules, including willingness of nations and the European Commission to adopt anti-tax avoidance measures applicable on corporate income taxation, the adoption of ATAD

measures by European institutions must be a surprise. This is because it is not so long ago, when the European Commission had been quite aware when it came to the elimination of tax barriers within the European Union internal market. For years the European Commission and the Court of Justice of the European Union watched cautiously compliance of the national anti-tax avoidance measures with fundamental rights and freedoms guaranteed by the now Lisbon Treaty. In fact, it is not so long time ago, when the European institutions were quite reluctant to accept existing national anti-tax avoidance measures.

Several judgements of the Court of Justice of the European Union state that national provisions governing exit taxation, thin capitalization rules or taxation of controlled foreign companies rules violate fundamental freedoms, mostly freedom of movement, freedom of establishment, freedom of payments, and freedom to provide services, all of them guaranteed by the EU law. Though, currently, almost out of the blue, the European Commission changed its mind and decided to lay down common harmonized rules of anti-tax avoidance measures and adopt ATAD.

Above in this paper there are listed *formal* reasons to introduce common harmonized anti-tax avoidance measures and adopt the ATAD. This paper aims to go further, dive deeper, and search for other, not publicly articulated reasons that might explain the sudden change of mind of the European Commission and Court of Justice of the EU concerning presence of the anti-tax avoidance measures in the national tax systems of the EU Member States.

The aim of this paper is to demonstrate that there are thoughtful differences in the attitudes of the European Commission and Court of Justice of the European Union towards presence and application of the anti-tax avoidance measure, namely exit taxation, before and after 2016. This paper is also inquiring the actual reasons that might lay behind the abrupt adoption of the ATAD measures.

To reach the goals, I adopt the legal analysis method and analyze judgements of the Court of Justice of the European Union that focus on national exit taxation legislation. I also search for those EU Member States that are likely to be mostly affected by the obligatory adoption of the common harmonized anti-tax avoidance measures.

The paper proceeds as follows: the second section presents details of the legal analysis procedure, and the third section presents results of the legal analysis, namely how exactly the Court of Justice of the EU had evaluated national exit taxation provisions before ATAD was adopted. This section also presents brief description of the currently adopted common harmonized exit taxation provisions laid by the ATAD. The fourth section discusses unspoken reasons for laying down common harmonized exit taxation measure. Finally, there is conclusion which summarizes findings and points out some open questions to be answered by future research.

2 Methodology and Data

As I have already mentioned earlier, this paper aims to show that there are significant differences in the approaches of the European Commission and the Court of Justice of the European Union towards presence and application of the exit taxation provisions before and after 2016. To make those differences observable, I compare current and former attitudes of the European Commission and the Court of Justice of the EU towards exit taxation.

To show *former* attitude of the EU institutions, I take a list of judgements of the Court of Justice of the EU about national exit taxation provisions launched before 2016, and subject those judgements to legal analysis where I am looking how the Court evaluated national exit taxation provisions before 2016. What I am interested in is to find, whether former non-common non-harmonized national exit tax provisions were pronounced as being in line with then EU law, or whether they were declared as national provisions that had violated the EU law.

Legal analysis of judgements of the Court of Justice of the European Union consists of three consecutive questions that must be answered in hierarchical order. They are as follows:

Question 1 focuses on the compliance and possible violation of the EU law.

- Do interrogated national exit tax provisions restrict some fundamental freedom guaranteed by the Treaty of the European Union or any provision of the Secondary EU Law?

Question 2 focuses on the justification of the national exit taxation rules.

- Can be the interrogated national exit tax provisions justified if the answer on the question 1 is affirmative?

Question 3 focuses on the proportionality of the national exit taxation rules.

- If the answers on questions 1 and 2 are affirmative, are the interrogated national exit tax provisions proportional to the goals they intend to pursue?

To show *current* attitude of the EU institutions towards exit taxation, I briefly describe exit taxation provisions as laid down by the ATAD in 2016.

Before running legal analysis I demonstrate presence of the exit taxation provisions in the national tax systems of the EU Member States. The aim is to indicate those European Union Member States that had not had any experience with such provisions before the common harmonized exit taxation rules were adopted in 2016.

3 Results

Let us first examine presence of the exit taxation rules before the ATAD was introduced. It is obvious (see **Table**), that national exit taxation rules were incorporated in the national tax systems of the most developed countries around the world. Out of the 35 OECD Member States there were 20 with national exit taxation rules, while 15 OECD Member States did not have exit taxation rules before 2016. Twenty OECD Member States had national exit taxation rules, out of them thirteen were most developed, "old" EU Member States. In contrast, before 2016 fifteen EU Member States did not have national exit tax provisions in their national tax systems, out of them thirteen post-communist countries. They were namely: Bulgaria, Croatia, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia. At the same time thirteen countries, all of them old EU MSs and members of the OECD had national exit taxation rules (Table).

Table 1 Presence of the National Exit Tax Rules in the EU Member States before Adoption of the ATAD

presence of national exit taxation rules							
yes				no			
		OECD MS	EU MS			OECD MS	EU MS
1	AUS	1	1	1	CZE	1	1
2	BEL	1	1	2	EST	1	1
3	DNK	1	1	3	GRE	1	1
4	FIN	1	1	4	HUN	1	1
5	FRA	1	1	5	LAT	1	1
6	DEU	1	1	6	POL	1	1
7	IRE	1	1	7	SLO	1	1
8	ITA	1	1	8	SVK	1	1
9	LUX	1	1	9	SWE	1	1
10	NLD	1	1	10	AUL	1	0
11	PRT	1	1	11	CHL	1	0
12	ESP	1	1	12	KOR	1	0
13	GBR	1	1	13	MEX	1	0

14	CAN	1	0	14	NZL	1	0
15	ICE	1	0	15	TUR	1	0
16	ISR	1	0	16	BUL	0	1
17	JAP	1	0	17	HRV	0	1
18	NOR	1	0	18	CYP	0	1
19	SWZ	1	0	19	LIT	0	1
20	USA	1	0	20	MAL	0	1
				21	ROM	0	1

Source: Author's own compilation based on (Deloitte, 2017)

The presence of the national exit taxation rules in the some EU Member States before 2016 created three major difficulties:

- *First*, national exit taxation rules in individual EU Member States become subject to investigation of the Court of Justice of the European Union because they had been accused of violation of fundamental freedoms guaranteed by the EU law.
- *Second*, national exit taxation rules had varied among the EU Member States making their tax regimes more unlike and different.
- *Third*, some EU Member States did not have any exit taxation rules. This situation might have triggered tax structuring and tax competition within the European Union.

Table 2 presents a list of judgements delivered by the Court of Justice of the European Union from 2002 to 2016; the subject matter of them was national exit taxation legislation. In fourteen cases out of sixteen the Court of Justice of the European Union or European Commission stated that national exit taxation rules *violated* or did not comply with the EU law provisions. The affected EU Member States were Netherlands (4 times), France (3 times), Deutschland (3 times), Spain (2 times), Portugal (2 times), and Denmark (1 time). These results suggest that national exit taxation rules were not, in general, welcomed by European Union institutions, either because they were alleged from violating the EU law, or they were found not justifiable or proportional.

Table 2 **Chyba! Nenalezen zdroj odkazů.** List of Judgements of the CJ EU and Infringement Proceedings Regarding the National Exit Tax Rules

Short case name		Case No	Defendant	Answers of the Court of Justice of the European Union		
				Q1	Q2	Q3
1	A Oy	C-292/16	FIN	yes	na	na
2	Jacob	C-327/16	FRA	yes	na	na
3	Picart	C-355/16	FRA	no	na	na
7	Trustees of the P Panayi Accumulation	C-646/15	GBR	yes	na	na
5	Verder Lab Tec GmbH & Co KG v Finanzamt Hilden	C-657/13	DEU	no	na	na
6	DMC Beteiligungsgesellschaft	C-164/12	DEU	yes	yes	yes
7	EC v Denmark	C-261/11	DNK	yes	na	na
8	EC v Spain	C-64/11	ESP	yes	na	na
9	EC v Netherland	C-301/11	NLD	yes	na	na
10	National Grid Indus BV	C-371/10	NLD	yes	yes	no
11	EC v Portuguese Republic	C-38/10	PRT	yes	yes	no
12	EC v Portuguese Republic	C-38/10	PRT	yes	na	na

13	EC v Spain	C-269/09	ESP	yes	na	na
14	EC v Germany	C-269/07	DEU	yes	na	na
15	Mr. N	C-470/04	NLD	yes	na	na
16	Lasteyrie du Saillant	C-9/02	FRA	yes	na	na

Legend: Q1 states for Question 1. Q2 states for Question 2. Q3 states for Question 3. The exact wording of all three questions is specified in the Section 2 in this paper.

Source: Author's own compilation

In the contrast of the previous judgements concerning the exit taxation legislation in some European Union Member States, the European Commission adopted Directive laying down rules against tax avoidance practices that directly affect the functioning of the internal market where it lays down common harmonized exit taxation provisions. They are placed in the Article 5 of ATAD, and they go as follows:

- A taxpayer shall be subject to tax at an amount equal to the market value of the transferred assets, at the time of exit of the assets, less their value for tax purposes.
- The tax shall be imposed if a taxpayer transfers assets, or its tax residence or business carried in one EU MSs to another EU MSs.
- If certain conditions are met, the taxpayer shall be given the right to defer the payment of an exit tax by paying it in instalments over five years.
- If taxpayer defers the payment, interest may be charged in accordance with the legislation of the EU MSs.
- If there is demonstrable and actual risk of non-recovery, taxpayers may also be required to provide a guarantee as a condition for deferring the payment.
- The taxpayer shall not be given the right to defer the payment if the legislation of the EU MSs provides for the possibility of recovery of the tax debt through another taxpayer.
- If a taxpayer defers payment, the deferral of payment shall be immediately discontinued and tax debt becomes recoverable immediately, if the transferred assets or business carried are sold or otherwise disposed of or transferred to the third country.
- The EU MSs of destination shall accept the value established by the EU MSs of the taxpayer (EC, 2016).

4 Discussion

Apart from formal reasons listed earlier in this paper, in my opinion it is possible to hypothesize four not articulated reasons why common harmonized exit taxation rules were adopted by the European Union institutions.

First, the reason why the European Union institutions changed their mind concerning the applicability of anti-tax avoidance measures is that the situation in the European Union changed, and also the European Union goals have changed. While before 2016 the highest priority was to develop and build the common internal European Union market ensuring fundamental freedoms and no tax barriers, after 2016, when the European Union common market has been already successfully built, the European Union institutions prioritize other goal: protection of the tax revenues by eliminating the aggressive tax planning practices.

Second, the reason which lays behind the ATAD measures is to unify, harmonize anti-tax avoidance measures so that former existing national measures are unified on the European Union level.

Third, not only the ATAD Directive does harmonize formerly existing national anti-tax avoidance measures. In addition the ATAD Directive forces those European Union Member States that did not have such measures before 2016, to adopt them now. This means, that the European Union latest attendants (EU-12) must introduce exit taxation measures into their national tax systems. The material effect of adoption of the ATAD is that by 2016 unknown exit taxation provisions must be adopted by twelve European Union Member States. To my knowledge there is no impact analysis on how incorporation of the common

harmonized exit taxation rules might affect economics and foreign investment flows in those countries. Yet, one may hypothesize that incorporation of the exit taxation rules might make those countries less competitive because they are likely to lose a tax advantage originating from soft or no anti-tax avoidance legislation they offered before 2016.

Fourth, anti-tax avoidance measures, including exit taxation rules were adopted shortly after the financial crisis 2008 had erupted and smoothed over. The European Union institutions that were formerly reluctant to adopt those measures changed its mind. In order to protect tax revenues from decline, the EU decided to launch those measures.

5 Conclusions

This paper provides analysis of the several former key decisions of the Court of Justice of the European Union (formerly European Court of Justice) concerning national exit taxation rules and compares those former decisions with the exit taxation provisions introduced by the ATAD.

In order to compare former Court of Justice of the European Union's decisions with measures adopted by the ATAD Directive, I employed the legal analysis method.

The legal analysis shows, that number of the former Court's decisions concerning national exit taxation measures were identified as violating the EU law and not being in compliance with the law provisions. Notwithstanding prior judgements of the Court of Justice of the European Union, and in contrast to some of them, the European Commission laid down common harmonized exit taxation rules. This shift might suggest that judgements of Court of Justice of the European Union and tax policy of the European Union institutions might not provide enough consistency and legal certainty.

The following questions remains open: what might be the financial effect of the introduction of the common harmonized exit taxation rules? How will business, multinational companies and wealthy individuals react? Will they anticipate exit taxation rules and decide not to settle there their future businesses, headquarters, permanent establishments and assets in the European Union? Will they prefer to settle out of the European Union to eliminate a risk of exit taxation payable later on? How much potential tax revenues will the European Union lose due to such potential outflow?

Acknowledgments

This paper is 1,0 result of the research project supported under the scheme VEGA 1/0776/16 Taxation of Financial Sector and Harmonization Tendencies in the EU funded by the Ministry of Education, Science, Research and Sport of the Slovak Republic.

References

- Brocke, K. V., Muller, S. (2013). Exit taxes: The Commission versus Denmark Case Analysed against the Background of the Fundamental Conflict in the EU: Territorial Taxes and an Internal Market without Barriers. *EC Tax Review*, vol. (6).
- Cédelle , A. (2016). The EU Anti-Tax Avoidance Directive: A UK Perspective. *British Tax Review*, vol. 16(4).
- Cerioni, L. (2013). The 'Final Word' on the Free Movement of Companies in Europe Following the ECJ's Valle Ruling and a Further Exit Tax Case? *European Taxation*, pp. 37-339.
- Chand, V. (2013). Exit Charges for Migrating Individuals and Companies: Comparative and Tax Treaty Analysis. SSRN Electronic Journal, retrieved from: doi:10.2139/ssrn.2250769.
- Commission of the European Communities (2006). Exit taxation and the need for co-ordination of Member States' tax policies. In: *Communication from the commission to the*

council, the European Parliament and the European Economic and Social Committee. Brussels: Commission of the European Communities, COM(2006) 825 final.

Council of the European Union (2016). Proposal for a Council Directive Laying Down Rules against Tax Avoidance Practices that Directly Affect the Functioning of the Internal Market. *Outcome of ECOFIN meeting 17 June 2016. FISC 104 ECOFIN 628.*

Deloitte (2017). *Tax Guides and Highlights*. Retrieved from: <https://dits.deloitte.com/#TaxGuides>

Deloitte (2018). *Tax guides and highlights*.

EC (2016). Council Directive (EU)2016/1164 of 12 July 2016 Laying down rules against tax avoidance practices that directly affect the functioning of the internal market.

Kubicová, J. (2016). Exit Tax in the World of International Migration of Companies and Individuals. In: *Globalization and its Socio-Economic Consequences. 16th International Scientific Conference 5th-6th October 2016*. Žilina: University of Žilina, pp. 1101-1109.

Man, F., & Tiiu, A. (2011). Contradiction Views of Exit Taxation under OECD MC and TFEU: Are Exit Taxes Still Allowed in Europe?. *Intertax*, vol. 39(12), pp. 621-622.

Parleani, G. (2005, July). Relocation and Taxation: The European Court of Justice Disallows the French Rule of Direct Taxation of Unrealised Gains. *European Company and Financial Law Review*, vol. 1(3), pp. 379-389.

Wattel, P. (2012). Exit Taxation in the EU/EEA Before and After National Grid Indus. *International Tax Notes*, pp. 371-372.

Financial Crisis Influence on Tax Mix Changes

Gabriela Kukalová¹, Lukáš Moravec², Jakub Ječmínek³, Barbora Martášková⁴

¹ Czech University of Life Sciences Prague
Faculty of Economics and Management, Department of Trade and Finance
Kamýcká 129, 165 21 Praha, Czech Republic
E-mail: kukalova@pef.czu.cz

² Czech University of Life Sciences Prague
Faculty of Economics and Management, Department of Trade and Finance
Kamýcká 129, 165 21 Praha, Czech Republic
E-mail: moravec@pef.czu.cz

³ Czech University of Life Sciences Prague
Faculty of Economics and Management, Department of Trade and Finance
Kamýcká 129, 165 21 Praha, Czech Republic
E-mail: jecminek@pef.czu.cz

⁴ Czech University of Life Sciences Prague
Faculty of Economics and Management, Department of Trade and Finance
Kamýcká 129, 165 21 Praha, Czech Republic
E-mail: matejkova.barca@gmail.com

Abstract: *The aim of the study is to evaluate the reaction of tax policy makers to financial crisis in the short term based on the statistical analysis of consequent tax mix changes in the EU member states. The paper describes the changes in tax structure of EU members, particularly focusing on the period 2008 – 2009. The analysis verifies the statistical significance of the financial crisis influence on the changes in tax structure of the EU member states. The post crisis changes statistical significance evaluation is realized particularly by using the paired t-test for defined groups of taxes and levies comparing the development nature in the period before and after the financial crisis in 2008 based on the data issued by EUROSTAT following the methodology ESA 95 valid in the period analyzed. The Statistica 12 software is used. The results show the statistically significant changes in tax mix as result of the slowed down economies in 2008 and also as the result of the stress on different group of taxes, applied by the policy makers, based on the tax avoidance resistance of different group of taxes.*

Keywords: *tax mix, tax structure, tax policy, EU, financial crisis*

JEL codes: *H20, H30, H68, E62*

1 Introduction

The tax mix informs about the tax structure in the given country, respectively to what share of taxes the given country gives priority. The structure of the tax mix of each country corresponds to their traditions and long-term fiscal policy. Discussing optimal tax structure is still a topical issue today. The main subject of the debate is the relationship between direct and indirect taxes in the tax system. Some countries are of the opinion that the tax burden imposed on the taxpayer should be largely exercised by its consumption through indirect taxes. This would ease the taxation of income, it would have a motivating effect on the job, and it would avoid taxpayers' general dislike to pay taxes.

An optimal tax mix is therefore the subject of a number of studies. The share of direct and indirect taxes in the tax mix is reported in contributions of Cremer, Pestieau and Rochet (2001). Eckerstorfer (2014) studied the optimal tax mix under asymmetric information in a two-type model, when individuals make relative consumption comparisons. Iosifidi and Mylonidis (2017) investigated effective tax rates that are directly comparable across OECD countries and over time. In their contribution, they point out that what matters from a redistributive standpoint is the tax mix rather than the tax rates in isolation from the rest. Huang and Rios (2016) investigated the optimal combination of a linear consumption tax

with a non-linear income tax for redistributive purposes. Kubátová and Štefanský (2016) in their contribution deal with the typology classification of tax systems of 28 EU member states in 2012 by applying variables of the tax quota and tax mix (shares of particular taxes in GDP).

The tax structure of the EU states also affects the tax competition, but above all the approximation of tax rules, tax coordination and harmonization. Vintila, Onofrei and Tibulca (2014) in their study present the evolution of taxation convergence tendencies within the European Union, using Sigma-convergence and cluster analysis. The aim of another study was to quantify the impact of single taxes and tax competition on the convergence of taxation in the EU (Bušovská and Bušovský, 2016). Delgado and Presno (2017) investigated tax convergence in 15 EU member states (data from 1975 to 2011). Bušovská (2014) in her contribution focused on the issue whether the tax systems in the EU member states are converging in the context of tax burden, tax mixes and implicit tax rates. Harmonization also penetrates other areas such as financial accounting. Hinke (2011) in his study analysed the harmonisation trends of the European Union, and used this analysis for a prediction of the development of financial accounting in the future.

Many authors in their studies assess the relationship between economic growth and the structure of taxes. Changes in the OECD tax mix in response to economic growth between 1980-1999 were examined by Tosun and Abizadeh (2005). According to Macek (2015), labor taxation (personal income taxes and social security contributions) is the most harmful for economic growth.

The tax mix also affects the tax burden in given country. As mentioned in European Commission (2017) the ration of tax collection (including social contribution) to GDP in EU-28 remain higher related to other well-developed countries. However, economists mostly agree that increasing tax burden discourages economy and implicates higher deadweight loss (Kubátová, 2009). Taxpayers' behavior is also related to the tax burden. Hinke, Zborková and Černá (2014), in their contribution, among others, notes the impact on the behavior of economic entities - legal persons. The subject of the study are also the possible social impacts of changes in the distribution of direct and indirect taxes (Smart, 2002).

The aim of our study is to evaluate the reaction of tax policy makers to financial crisis in the short term based on the statistical analysis of tax mix changes in the EU member states. The paper focuses mainly on the changes in 2008-2009.

2 Methodology and Data

Our research focusing on the impact of the financial crisis on the tax mix is a part of a wider study of the development of EU tax mixes. The states of the then EU-27 were divided into four groups according to geographical location - Nordic, Southern, Western and Eastern (Table 1). The former post-communist states, including the Baltic States, have been ranked among the eastern states, which have undergone a gradual transition from a centrally planned economy to a market one in the past two decades.

Table 1 Classification of EU-27 States into Groups According to Geographic Location

— Group	— States
Northern States (N)	Denmark (DK), Finland (FI), Sweden (SE)
Southern States (S)	Italy (IT), Cyprus (CY), Greece (EL), Malta (MT), Portugal (PT), Spain (ES)
Western States (W)	Austria (AT), Belgium (BE), France (FR), Germany (DE), Ireland (IE), Luxembourg (LU), Netherlands (NL), United Kingdom (UK)
Eastern States (E)	Bulgaria (BG), Czech Republic (CZ), Estonia (EE), Hungary (HU), Latvia (LT), Lithuania (LV), Poland (PL), Romania (RO), Slovenia (SI), Slovakia (SK)

Source: own work

The development of the tax mix of the EU countries has been monitored since 2004, when the European Union expanded at the most. Both Bulgaria and Romania were included in the analysis of the development of the EU average mix of taxes and individual groups of countries. (These countries were candidates for accession in 2004 and are members of the EU since 2007). The data used in our research follow the methodology of the European System of Accounts (ESA 95), which was in force in the monitored period (European Commission, 2014).

The average share of selected taxes and social insurance revenues of the EU-27 tax mix (including Bulgaria and Romania in 2004-2006) and the tax mix of the established groups of countries were monitored between 2004 and 2012 (4 years before the transfer of the crisis to Europe (2008) and another four years after the transfer to Europe). The evolution of shares in the tax mix is shown in charts 1, 2 and 3. The average EU-27 tax mix, the average of tax mixes of individual groups of countries and the real values of the tax mix of all member states were considered in these analyses. The assessment of the change in tax mixes because of the financial crisis was carried out in the then EU-27 countries (without Croatia, which became a member of the EU in 2013).

Based on the analysis of the development of the share of individual taxes and social insurance revenues on the tax structure of the EU-27 states, significant changes in the tax mix between 2008 and 2009 were found (Table 2).

An analysis was subsequently carried out to determine whether the financial crisis had a statistically significant effect on the structure of the tax mix of the 27 EU Member States in 2008-2009. The analysis was carried out by testing selected taxes (personal income tax, corporate income tax, Value Added Tax, consumption taxes) and social security contributions. The data normality was verified by the Kolmogorov-Smirnov test at the significance level of 0.05.

The statistical test using Student paired t- test was used to assess the impact. The measurement was carried out on a selected sample of the selective aggregation; the measurements were compared before the change in the share of the tax or the social revenues (2008) and after the change (2009). Testing against each other is always subject to a zero and alternative hypothesis. The following zero hypotheses were formulated:

- H01: The value of the average share of personal income tax in total tax revenues in 2008-2009 did not change, the financial crisis did not have a statistically significant effect on possible changes in the structure of the tax mix.
- H02: The value of the average share of corporate income tax in total tax revenues in 2008-2009 did not change, the financial crisis did not have a statistically significant effect on possible changes in the structure of the tax mix.
- H03: The value of the average share of social security contribution in total tax revenues remained unchanged in the period 2008-2009, the financial crisis did not have a statistically significant effect on possible changes in the structure of the tax mix.
- H04: The value of the average share of value added tax in total tax revenues in 2008-2009 did not change, the financial crisis did not have a statistically significant effect on possible changes in the structure of the tax mix.
- H05: The value of the average share of consumption taxes in total tax revenues remained unchanged during the period 2008-2009, the financial crisis did not have a statistically significant effect on possible changes in the structure of the tax mix.

The result of the test was decided based on the comparison of the p-value with the significance level $\alpha=0.05$. Analytical software Statistica 12 was used for statistical calculations.

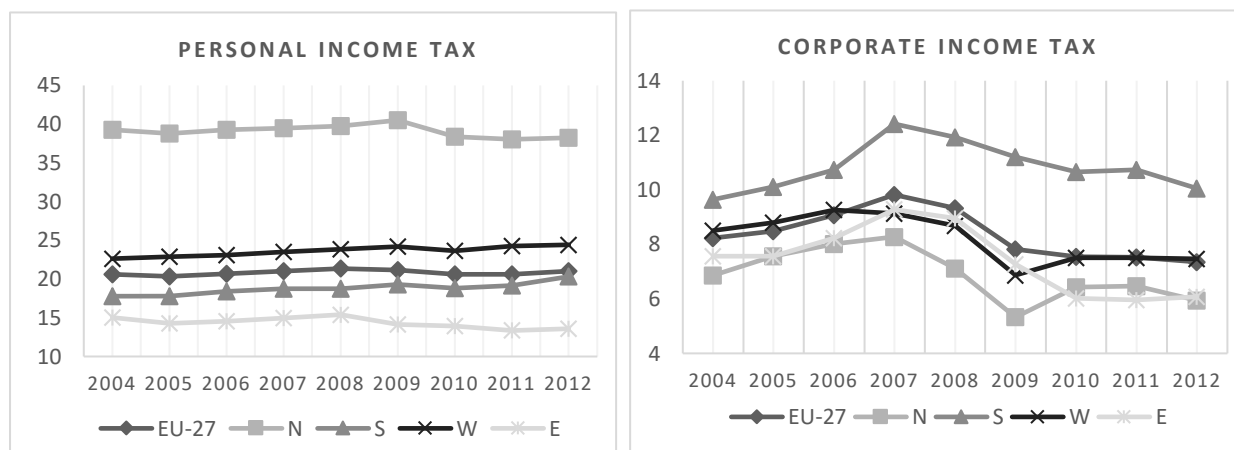
3 Results and Discussion

The assessment of the evolution of average shares of selected taxes and social security contributions in the tax mix of the EU-27 countries and the established groups of countries took place in the period 2004-2012.

Average shares of selected taxes and social security contributions in the tax mix

Based on the analysis of the evolution of average shares of selected taxes and social security contributions in the EU-27 tax mix and the established groups of countries, it was found that the biggest changes occurred between 2008-2009.

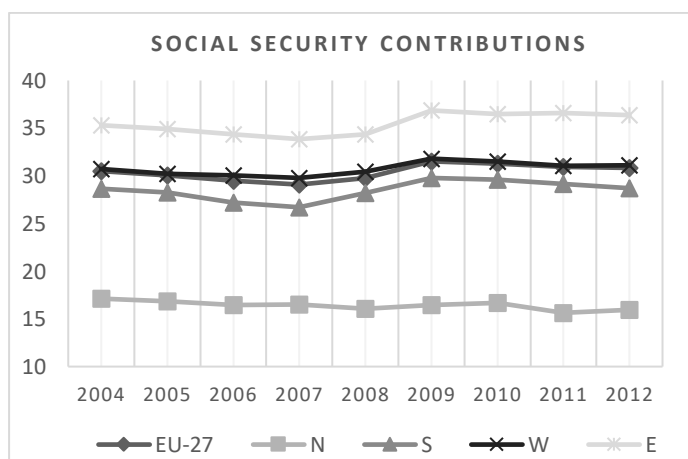
Figure 1 Shares of Selected Direct Taxes in the EU-27 Tax Mix and Groups of States (%)
(left: Personal Income Tax, right: Corporate Income Tax)



Source: European Commission (2014), own work

The average share of personal income tax in the tax mix is long-term the highest in the case of a group of Nordic countries (Figure 1, left: Personal Income Tax). The high share is mainly due to Denmark, which finances retirement benefits from this tax, and causes some distortion for the entire Nordic group. Changes in personal income tax have been around 0.5% for the long-term, the only exception was a 1.3% decrease for the eastern group after 2008. Since then, the share of the Nordic and Eastern countries has declined, with a slight increase in the western and southern countries. Figure 1 (right: Corporate Income Tax) shows the variability of the share of corporate income tax, which is an important tool for tax competition among states. Since the outbreak of the financial crisis, it has been possible to observe a significant drop in shares for all groups of countries after 2007. Between 2007 and 2010, a number of countries experienced significant changes in tax rates, exemptions, or additional tax. A significant drop of the share of corporate income tax in the tax mix occurred in the Eastern Group of States. Between 2008 and 2019, the share decreased by 1.6%.

Figure 2 Share of Social Security Contributions in the EU-27 Tax Mix and Groups (%)

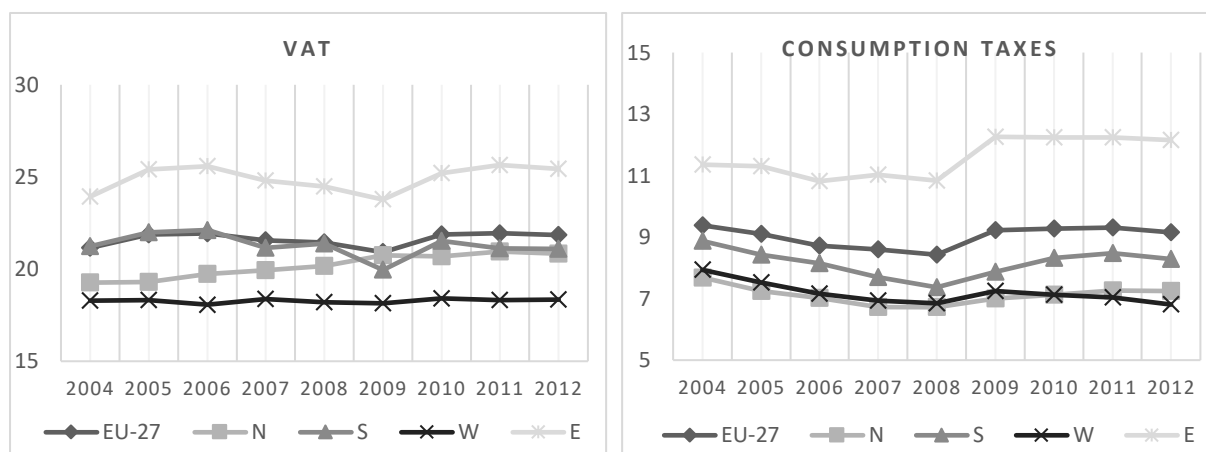


Source: European Commission (2014), own work

The share of social security contributions is the lowest in the Nordic countries (Figure 3).

South and West countries show almost identical trends and jointly copy the development of the average curve of all EU-27 member states. The Eastern Group of States is well above the average of the other groups. Even though the average shares of the groups varied very slightly, there were significant changes in individual countries between 2008-2012. Example of major changes are Lithuania (+9%), Cyprus (+5.6%) and Poland (+4.6%). The largest growth rate was recorded for the Eastern group of countries by 5.6%.

Figure 3 Share of Selected Indirect Taxes in the EU-27 Tax Mix and Groups of States (%) (left: Value Added Tax; right: Consumption Taxes)



Source: European Commission (2014), own work

The average share of VAT in the EU-27 tax mix and individual groups changed most in 2008-2010 (Figure 3, left: Value Added Tax). Between 2008 and 2009 there was a decrease in the share (except for the Nordic countries); on the contrary, between 2009 and 2010 the share of VAT in the tax mix increased, especially for the group of southern and eastern countries. The average share of consumption taxes in the tax mix increased between 2008-2009 for all groups of countries (Figure 3, right: Consumption Taxes). The largest increase in the share is evident in eastern countries (1.4%), while in the Nordic group increased by only 0.3%. The average share of consumption taxes in the EU-27 increased by 0.8%.

Changes in average share of taxes and social security contributions across EU-27 countries are shown in Table 2. Based on these data are tested statistical hypotheses.

Table 2 Share of Selected Taxes in the EU-27 tax mix (%) in 2008 and 2009

Group	State	Personal income tax		Corporate income tax		Soc. security contributions		VAT		Consumption taxes	
		2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
N	DK	52.6	55.2	6.9	4.9	2.0	2.0	21.0	21.3	6.6	6.8
	FI	30.9	31.2	8.1	4.7	28.0	29.9	19.5	20.2	7.7	8.0
	SE	35.8	35.1	6.3	6.4	18.2	17.4	20.0	20.7	5.8	6.2
S	IT	27.4	27.2	7.2	5.7	31.4	31.9	13.9	13.3	4.5	4.9
	CY	13.0	11.2	18.4	18.4	20.1	24.6	27.4	26.0	8.6	9.1
	EL	15.0	16.3	7.8	8.1	34.7	34.2	22.7	22.1	7.2	8.4
	MT	17.8	19.7	18.4	18.3	17.9	17.7	23.3	22.9	9.0	8.8
	PT	17.0	18.4	11.1	9.2	26.8	29.1	25.6	22.9	8.3	8.8
	ES	22.3	23.0	8.6	7.5	37.4	40.5	15.5	13.5	6.6	7.2
	W	AT	24.4	23.4	6.2	4.4	33.6	35.0	18.2	18.9	5.8
W	BE	28.4	28.2	7.6	5.6	31.5	33.4	15.7	16.0	4.7	4.9
	FR	18.1	18.0	6.3	3.0	37.7	39.9	16.5	16.4	4.9	5.1
	DE	23.2	23.1	6.9	5.0	39.1	40.3	18.3	19.0	6.6	6.8
	IE	27.9	27.8	9.8	8.7	18.1	20.5	24.6	22.7	8.3	9.6
	LU	21.7	20.6	14.3	14.7	28.3	29.8	16.8	17.3	9.8	9.7

	NL	18.4	22.4	8.8	5.6	37.0	36.2	18.5	18.3	6.0	6.0
	UK	28.5	30.0	9.6	8.0	18.1	19.4	16.9	16.4	8.6	10.1
E	BG	28.4	28.2	9.8	8.8	24.1	26.6	33.8	31.1	18.4	18.8
	CZ	10.7	10.8	12.2	10.5	45.1	44.5	19.7	20.6	9.5	10.9
	EE	19.5	16.0	5.1	5.2	36.6	36.9	24.9	24.8	10.4	14.1
	HU	19.0	18.5	6.5	5.4	34.0	32.9	19.3	21.3	8.3	8.9
	LT	21.8	20.4	10.9	5.9	28.3	32.0	23.0	22.5	11.0	13.9
	LV	21.3	3.6	8.9	6.0	31.3	42.0	26.0	24.2	9.9	11.4
	PL	15.6	14.6	7.9	7.2	33.0	35.7	23.4	23.4	13.0	11.9
	RO	12.1	13.1	10.7	9.9	33.3	34.9	28.2	24.7	9.6	11.8
	SI	15.7	15.7	6.7	4.9	37.7	40.1	22.8	21.6	9.0	11.1
	SK	9.4	8.5	10.7	8.8	40.7	43.6	23.8	23.4	9.3	9.8
	EU-27	21.4	21.2	9.3	7.8	29.8	31.5	21.5	20.9	8.4	9.2

Source: European Commission (2014), own work

Testing of statistical hypotheses

The Paired Student's T – Test was applied to verify the hypothesis as the T – Test confirms the (non)existence of statistically significant differences between the averages of two selected groups of items.

Table 3 Paired t-test: Personal Income Tax, Corporate Income Tax

	Personal Income Tax		Corporate Income Tax	
	2008	2009	2008	2009
Average share	21.35256337	21.18591463	9.326267333	7.810643407
Number of observations	27		27	
t	0.408179472		6.176503512	
t crit. (26)	1.706		1.706	
p	0.686483998		0.000002	
α	0.05		0.05	

Source: European Commission (2014), own work

According to the performed calculations, the zero hypothesis H01 (Table 3) can't be rejected. Thus, it is valid the assumption that as regards the personal income tax the financial crisis did not have a statistically significant effect on a moderate reduction of the share of tax in the total tax mix for the 27 EU member states. Changes that have occurred in individual Member States may in part be attributed to the financial crisis, but its overall impact has not been statistically confirmed.

The zero hypothesis H02 can be rejected. And we accept an alternative hypothesis. It was confirmed the assumption that the financial crisis had a statistically significant impact on the share in the tax mix of 27 EU member states. Regarding corporate income tax, we can unequivocally confirm the significant impact of the crisis on the reduction of the share. At the mean value of each period, we can see a demonstrable decrease of the share in total tax revenue.

Table 4 Paired t-test: Social Security Contributions

	Social Security Contributions	
	2008	2009
Average share	29.78052329	31.51421167
Number of observations	27	
t	- 3.892	
t crit. (26)	1.706	
p	0.0010	
α	0.05	

Source: European Commission (2014), own work

On the basis of the above data (Table 4), the zero hypothesis H03 of statistical insignificance is rejected. The financial crisis had a statistically significant effect on increasing the share of social insurance in the overall tax mix. In the monitored period, the mean value increased significantly.

Table 5 Paired t-test: VAT and Consumption Taxes

	VAT		Consumption Taxes	
	2008	2009	2008	2009
Average share	21.45299111	20.91473407	8.426352185	9.215474815
Number of observations	27		27	
t	2.161352387		-3.985292671	
t crit. (26)	1.706		1.706	
p	0.040057407		0.000485778	
α	0.05		0.05	

Source: European Commission (2014), own work

Based on the calculations performed, the zero hypothesis H04 (Table 5) is rejected. According to the alternative hypothesis, the financial crisis had an overall statistically significant effect on the VAT share in the EU-27 tax mix. The largest differences were reached in the group of eastern countries, the biggest rise of the shares recorded Hungary and the Czech Republic, while Romania and Bulgaria experienced the most significant decline.

It also follows from the calculations that the zero hypothesis H05 can be rejected (Table 5). An alternative hypothesis was adopted when the financial crisis had a demonstrably statistically significant impact on the share of consumption taxes in the tax mix of the 27 EU member states. Year-on-year comparison has seen a significant change in mean values.

The impact of the financial crisis on the change of the share of individual taxes in the tax mix has not yet been evaluated, according to available sources. Changes in the structure of the tax mix are often assessed in terms of setting rates (Iosifidi and Mylonidis, 2017) or setting up an optimal tax mix (e.g. Cremer, Pestieau and Rochet, 2001; Eckerstorfer, 2014; Huang and Rios, 2016). The impact of economic growth (eg Macek, 2015; Tosun and Abizadeh, 2005) was also studied. Široký and Maková (2014) verified the relationship between the growth rate of the gross domestic product and the public deficits on one hand and the change of VAT rates on the other hand in 27 European Union Member States within the period of 2008-2013. The influence of tax systems harmonization and convergence (Bušovská and Bušovský, 2016; Delgado and Presno, 2017 and others) was also evaluated. The influence of tax mix changes and tax rates modifications on taxpayers and consumers behavior was confirmed by Hinke, Zborková and Černá (2014) and Krzikallová (2016). The conclusions of the above-mentioned studies are in line with the presented results confirming the crisis in 2008 changed the tax policies globally.

4 Conclusions

An analysis of the impact of the financial crisis on the structure of the EU-27 tax mix has produced interesting results. Changes in average tax shares or social security contributions are apparent between 2008-2009. However, these changes cannot be attributed solely to the financial crisis. The share of a tax in the tax mix is also affected by other factors, such as a change of the rate.

In the case of the personal income tax, the test showed that the share changes were statistically insignificant. This was due to changes that only occurred in a small number of countries and in the upshot, became equal among themselves. Since 2009, the share of this tax has declined, potentially due to the fact that the member states adopted a number of measures to support national economies. The measures consisted in narrowing the bases of personal revenue tax and extending tax reliefs in order to better reflect the social position of taxpayers. Statistically significant was the impact of the financial crisis on corporation tax. Between 2008-2012, the share of this tax in the average tax mix of EU-

27 countries decreased by approximately 21%. Changes in social security contributions were evaluated as statistically significant. The share of social insurance, despite the financial crisis, was the only one of all tax groups and contributions continued to grow slightly. Testing of value added tax and consumption tax showed changes in both sub-groups of indirect taxes, the changes resulting from the financial crisis were statistically significant. For both taxes, a number of measures was adopted, including extensive adjustments in tax legislation, particularly in the area of increase of tax rates. Value added tax, particularly in southern countries severely affected by financial crisis, has seen frequent increases in tax rates. The eastern countries then manifested themselves in the introduction of a new, further reduced tax rate.

Acknowledgments

This paper is a partial result of the research project No. 20171032 - Czech tax gap as a consequence of profit shifting quantification and its factors identification, supported by the Internal Grant Agency (IGA) of Faculty of Economics and Management, CULS Prague.

References

- Bušovská, M. (2014). Convergence of Tax Burden, Tax Revenues and Implicit Tax Rates in the European Union Member States. *Ekonomický časopis*, vol. 62(4), pp. 363-376.
- Cremer, H., Pestieau, P., Rochet, J. C. (2001). Direct versus indirect taxation: The design of the tax structure revisited. *International Economic Review*, vol. 42(3), pp. 781-799.
- Delgado, F. J., Presno, M. J. (2017). Tax Evolution in the EU: A Convergence Club Approach. *Panoeconomicus*, vol. 64(5), pp. 623-643.
- Eckerstorfer, P. (2014). Relative Consumption Concerns and the Optimal Tax Mix. *Journal of Public Economic Theory*, vol. 16(6), pp. 936-958.
- European Commission. (2014). *Taxation trends in the European Union 2014: Annex B – Methodology and explanatory notes*. Retrieved from: https://ec.europa.eu/taxation_customs/sites/taxation/files/docs/body/methodology.pdf.
- European Commission. (2017). *Taxation trends in the European Union: 2017 edition*. Retrieved from: https://ec.europa.eu/taxation_customs/sites/taxation/files/taxation_trends_report_2017.pdf.
- Hinke, J. (2011). Evolution Trends in Finance Accounting in the European Union. In: *Conference on New Trends in Business Management in Theory and Practice in Cross-Border Comparison*. Mariánské Lázně: GUC Fachbuchreihe, pp. 47-54.
- Hinke, J., Zborková, J., Černá, M. (2014). The Methodology of Sustainable Business Performance Indicators Determination. In: *23rd International-Business-Information-Management-Association Conference on Visio 2020: Sustainable Growth, Economic Development, and Global Competitiveness*. Valencia, pp. 1033-1047.
- Huang, J., Rios, J. (2016). Optimal tax mix with income tax non-compliance. *Journal of Public Economics*, vol. 144, pp. 52-63.
- Iosifidi, M., Mylonidis, N. (2017). Relative effective taxation and income inequality: Evidence from OECD countries. *Journal of European Social Policy*, vol. 27(1), pp. 57-76.
- Krzikallová, K., Střílková, R. (2016). Labour-Intensive Services and Changes in Value Added Tax Revenue. *Journal of Competitiveness*, vol. 8(1), pp. 5-18.
- Kubátová, K. (2009). Optimal Taxation: An Overview of the Current Theory. *Český účetní a finanční časopis*, vol. 4(3), pp. 24-36.
- Kubátová, K., Štefanský, M. (2016). Classification of Tax Systems of European Union Countries according to Tax Mix in 2012. In: Sedmíhradská, L., ed., *Theoretical and Practical Aspects of Public Finance 2016*, Prague: University of Economics, Dept. Publ. Finance, pp. 42-45.

Macek, R. (2015). The Impact of Individual Types of Taxes on Economic Growth in OECD Countries: Dynamic Panel Regression. *Ekonomický časopis*, vol. 63(7), pp. 718-736.

Smart, M. (2002). Reforming the direct-indirect tax mix. *International Tax and Public Finance*, vol. 9(2), pp. 143-155.

Široký, J., Maková, K. (2014). Economic Crisis and the Movement of the Value Added Tax Rates in the European Union Member States. In: *Proceedings of the 2nd International Conference on European Integration 2014 (ICEI 2014)*. Ostrava: VSB – Technical University of Ostrava, pp. 684-692.

Švec Bušovská, M., Bušovský, L. (2016). The Impact of Single Taxes on the Convergence of Taxation in the European-Union. *Ekonomický časopis*, vol. 64(9), pp. 894-908.

Tosun, M. S., Abizadeh, S. (2005). Economic growth and tax components: an analysis of tax changes in OECD. *Applied Economics*, vol. 37(19), pp. 2251-2263.

Vintila, G., Onofrei, M., Tibulca, I. L. (2014). Fiscal Convergence in an Enlarged European Union. *Transylvanian Review of Administrative Sciences*, issue 41E, pp. 213-223.

Environmental Risk Insurability Issues – the EU Perspective

Malwina Lemkowska

Poznań University of Economics and Business
Faculty of Economics, Department of Insurance
Al. Niepodległości 10, 61-875 Poznań, Poland
E-mail: malwina.lemkowska@ue.poznan.pl

Abstract: *The aim of this paper is to evaluate insurability of environmental risk. Juxtaposition of the attributes of both environmental risk and insurance market against risk insurability factors will be the evaluation criterion. Two groups of insurability criteria have been identified: endogenous and exogenous ones. Exogenous criteria of insurability refer to the attributes of the risk itself. Exogenous ones are connected with the features of the insurance market and its participants, especially the ability of the insurance companies to deal with the specific risk. The level of environmental risk insurability is relatively low. It is because of the problem with fulfilment of both endogenous and exogenous criteria. The occurrence, which results in environmental damage is very often not sudden, random and extraordinary. The probability of accident and probable maximum loss are difficult to estimate. Additionally, environmental risk results often in catastrophic loss. Although insurance companies provide relatively high capacity, they have problem to create sufficiently large insurance portfolio.*

Keywords: *environmental insurance, environmental risk, insurability of risk*

JEL codes: *G22, Q50, K21*

1 Introduction

Evaluation of risk insurability is the basis of insurers' operations. The purpose of this article is to assess the insurability of environmental risk. Insurability is a changeable phenomenon, firstly, because of continuous evolution of risks, and secondly, technological progress concerning insurance offer. Along with an increasing number of threats in economic reality risk is becoming an ever more complex notion. Ultimately, it causes entrepreneurs to acknowledge more readily the types of risks which traditionally did not use to be subject to insurance (Swiss Re, 2017). Development of data processing technologies as well as the evolution of the methods of insurance products creation is continually increasing insurers' competencies in covering formerly uninsurable risks.

2 Methodology and data

Research findings presented in this paper are the outcome of review of the subject literature on risk insurability criteria, on the one hand. On the other, an overview of legal acts on environmental law allows to identify the attributes of environmental risk. The criterion for insurability evaluation will involve a juxtaposition of the attributes of environmental risk and insurance market against risk insurability factors.

3 Results and discussion

Environmental risk

The environmental risk is understood narrowly in the article, i.e. environmental liability risk. The above results from economic practice: environmental insurance is mainly concerned with legal liability insurance. In the EU the scope of this liability is determined by Community legal acts, international conventions, (nuclear and oil-related damage) and member countries' legal acts.

Features of insurable risk

Thanks to the review of the subject literature one can distinguish more than ten risk factors of insurability. Scientists propose a variety of criteria to categorise them. Fedor (2004) names 11 features of risk insurability and divides them into two groups: absolute and

relative ones. The first one contains the conditions which absolutely have to be met to make the risk insurable (i.e. it must be a future and random event, independent of the insured's will, assessable and capable of being classified within a similarly characterised set). The other one consists of features which determine insurability in a non-definitive way (appropriate frequency of occurrences, price, susceptibility of an occurrence to phenomena related to information asymmetry i.e. moral hazard, adverse selection). Berliner (1982), in turn, identifies actuarial criteria of insurability, which require independence of risks and reliable estimation of loss probabilities (randomness of loss occurrence), manageable maximum possible losses per event in terms of insurer solvency (maximum possible loss), moderate average loss amounts per event (average loss per event), a sufficiently high number of loss events per annum (loss exposure) and no excessive information asymmetry problems (i.e. moral hazard, adverse selection). Berliner also distinguishes insurability factors determined by markets. He lists there: insurance premium level (adequate to the scope of risk, affordable), limits of insurance cover (acceptable), insurance sector capacity (sufficient). Furthermore, social conditions of risk insurability identified by Berliner refer to public policy and the legal system - insurance cover should not contradict them (Biener, Eling, Wirfs, 2015). Rejda (2014) presented the concept of ideally insurable risk. Hence, he turns one's attention to gradability of risk by giving the example of a blaze as an ideally insurable risk and unemployment as an instance of uninsurable risk. Vaughan and Vaughan (2008) mention "ideal" elements of insurable risk. These are: sufficiently large number of homogenous exposure units to make the losses reasonably predictable, definite and measurable loss produced by the risk, fortuitous or accidental loss and non-catastrophic loss. Outreville (1997), in turn, points out that ideally insurable risk is pure, static and particular. Even if, however, ideal insurability criteria are not met, a given risk may not remain uncovered (Vaughan and Vaughan, 2008). According to Faure (2001), this can be explained by the concept of 'insurer ambiguity' (Kunreuther, Hogarth, Meszaros, 1993). Its authors assert that an insurer may offer insurance cover against the types of risk which, due to their lack of compliance with measurability and predictability criteria, are considered as uninsurable. In such case the insurer charges additional premium. Therefore, Faure (2001) does not refer to insurability criteria and points to factors which determine it in a positive or negative way.

All the above factors could be categorized as **endogenous toward risk**, i.e. features of the risk itself, or as **exogenous** (the attributes of a particular insurance market). A future occurrence which is sudden, random, independent of one's will, measureable, capable of being classified within a similarly characterised set, extraordinary, resulting in reasonable damage and statistically independent can be said to meet the endogenous criteria of insurability. Exogenous conditions of insurability are met if insurers manage to control moral hazard and adverse selection, have sufficient insurance capacity, offer acceptable limits and price for the cover which are in line with their tendency to accept risk, and act in favourable circumstances relating to public policy and legal system.

Gradability of insurability categories

The concept of insurability may be interpreted in two ways. Firstly, a risk is insurable if insurers supply cover; secondly, insurability is contingent on its doctrinal criteria (endogenous attributes of risk), (Knight, 1921). In both cases insurability is a gradable category. Assuming the first approach, B. Berliner uses abstract terms of objective and subjective insurability (Berliner, 1985). The first one refers to declarations made by all potential insurers operating in the area of the given risk category that they will cover this risk (objectively insurable risk). Subjective insurability, in turn, is linked with only one individual insurer's readiness to cover a risk. This implies that between the area of objective insurability and objective uninsurability there is a space where only a few insurers offer protection. It determines the degree of this risk's insurability.

In the case of insurability viewed from the other perspective (determined by the risk attributes) this category remains gradable, just as the assessment of particular features of this risk can be gradable as well (e.g. more or less easily measureable). Changeability of

insurance supply as well as the evolution of the assessment of particular risk features in time determine the dynamics of the degree of insurability.

Environmental risk insurability – endogenous approach

Environmental risk is insurable within the area of subjective insurability. Only a few property insurers offer environmental products. One can put hypothesis that environmental risk does not meet all the criteria for endogenous insurability.

If it comes to the first premise for risk insurability (insurance accident has to realise in future), it raises doubts in the context of the natural environment. The “future” attribute may refer to different factors of risk: firstly, it may imply the event resulting in environmental damage (peril); secondly, to the damage itself; thirdly, its disclosure and finally the claim on the damage to be remedied. The timespan between the damage occurrence and the claim being made may be significantly large. This may be caused by the long stage of the damage latency⁵, lack of peril peculiarity⁶, gradual accumulation of the damage (serial damage, accumulative damage)⁷. What is more, the long timespan may cause more likely the damage resulting from a reaction of primary pollutant with other substances, either natural or emitted by other entities. Additionally, the future event should be sudden (Guevara, Deveau, 2012), which cannot be assigned to the attributes of accumulative damage⁸.

In order to overcome insurability barriers companies may prepare “claims-made” products (Swiss Re, 2009). Making a claim – as an insurance accident – meets the condition of being a future and sudden event. Nonetheless, evaluation of the insured’s past operations within underwriting process becomes a challenge to insurers.

Occurrence, which can result in damage should be random (many entities may face it and it is impossible to point at the particular entity affected by the risk) and extraordinary. Randomness refers not only to the event occurrence itself, but also its timing and consequences. The nature of environmental damage which results from business activity raises doubts about both randomness regarding the event itself and extraordinariness of risk, especially in the case of business sectors which are particularly dangerous to the environment, often requiring special permits to run business operations. Although European regulations (article 8 section 4 of ELD⁹) make it possible to abolish environmental damage liability (so called *permit defence*), the ultimate decisions about liability exemptions are made by individual member states. Seven states have decided to levy the burden of liability for environmental damage on entities operating within the permit’s scope (Belgium, Bulgaria, Germany, Hungary, Poland, Romania and France), (Bio Intelligence Service in association with Stevens&Bolton LLP, 2009; Faure, Grimeaud, 2000)⁹. As a result, randomness of the event becomes reduced, at the most, to the time of damage occurrence or to its implications, while extraordinariness often becomes eliminated (Bio Intelligence Service in association with Stevens&Bolton LLP, 2009). The problem arises especially with respect to insurance against dispersed pollution effects, where pollution amasses from various sources or reacts with other (external) chemical substances and only then does it generate environmental damage. The European regulations assume that as long as pollution can be assigned to a particular company or a confined conglomerate of businesses, administrative liability arises. Moreover, polluters have to consider a constantly

⁵ A direct damage (e.g. water contamination) is discovered often through indirect damage (e.g. a drop in a particular fish species population in the contaminated area).

⁶ Environmental damage is generated not only by so called direct pollution occurrences (explosion, container leakage), but also non-pollution occurrences, e.g. flood, blaze.

⁷ E.g. river contamination caused by filtering of rainwater through artificially fertilised soil.

⁸ Inability to meet the criterion of “suddenness” was the reason for denial of compensation payments for environmental liability in the past in the USA (Naylor, Dybdahl, 2012).

⁹ The authors emphasized, that businesses acting in accordance with regulatory standards are not exempt from environmental damage liability. Hence, a socially effective protection of natural resources may require an implementation of higher standards than the legally established ones.

growing likelihood of claims on the grounds of civil law. A lot of attention has been paid to the court sentence concerning Kivalina, an Eskimo village in Alaska which filed a claim against numerous entities' insurers who had based their operations on coal power. Global warming, resulting from coal used as fuel, led to melting of the ice which protected the village from storms. Virginia state court, having analysed the insurance contracts signed by the polluters, pronounced lack of insurance cover for the occurrence described. This does not mean, however, that there are no legal grounds for a non-insurance claim against the authors of the damage and there will be no demand for cover in the future.

Pollution which naturally results from a particular business activity and is socially acceptable (in particular, as proven by a legal permit), which is a compromise between economic and environmental interests within the concept of sustainable development¹⁰, cannot meet another insurability criterion, i.e. independence of the insured's will.

Two reversed cycles of insurers' operations (i.e. distribution prior to production and price setting prior to defining costs) touch upon the issue of risk measurability criterion. The basis for premium calculation should be a data base containing records of past random events (probabilistic risk, qualified as insurable). Estimative risk, in turn is difficult to insure (Knight, 1921). Environmental risk is in a great part an estimative one. There are at least three reasons for this. Firstly, the level of environmental knowledge still does not make it possible to assess the impact of polluting substances on the natural environment and human life and health. Secondly, although environmental damage has long been included in the regime of the polluter's liability, in the past it was hardly ever followed through (especially in the area of the environment as a common good). The third reason is that the polluter's liability is continually broadened and – according to ELD – polluters are not only held responsible for essential remedial actions but also for compensational and complementary actions. The problem of measurability appears in particular in connection with environmental liability for actions, as for which, according to the present state of technical and scientific knowledge, adverse effect on the environment has been impossible to predict (so called *state-of-the-art defence*), (article 8 section 4 of ELD). In this area, the risk cannot be categorised either as probabilistic or estimative risk. It is totally unmeasurable and consequently, endogenously uninsurable. The ELD allows exemption of the above from the polluters' liability, nonetheless, many countries, including Poland, have given up this right.

Environmental risk may materialise with reference to a large number of entities. Although the ELD pronounces administrative liability only with regard to professional activities, and additionally, in the case of damage done to waters and land surface, limits the subjective scope to the activities enumerated in the appendix, member states are eligible to expand and do expand the regulation. From the point of view of insurance, though, what matters is the size of the group which presents demand for insurance cover. Unfortunately, the European Commission's study shows a very low level of demand for insurance (European Commission, 2016). Main reasons for this situation are: lack of public reports informing about environmental damage materialisation and lack of adequate execution of environmental liability.

Environmental risk may generate catastrophic damage. First of all, it is caused by large mobility of environmental damage. Secondly, the scope of environmental liability is systematically broadened through regulations. A special example of the latter is the analysis conducted by the French government. The study concerned two instances of environmental damage which occurred in 1996 and 1997. The costs of remedying these two cases according to the legal status of the time amounted to \$ 67 K and 16 K respectively. Analyses showed that if such damage were to happen at present – under the ELD – the costs of remedying would skyrocket to \$ 636 K and \$ 6.4 m (Institute of Sustainable Development, 2010; ACE Group, 2011). History presents a whole array of occurrences generating exorbitant costs of remedying them. It is enough to mention just

¹⁰ The most problematic from the point of view of insurance is chronic pollution, besides diffuse pollution, long-distance pollution and historical pollution (Swiss Re, 2003).

a few: the Boliden's Doñana (Spain) accident in 1999 (approx. € 240 m (El Pais, 2010)), Kolontar, Hungary (approx. € 65 m (ACE Group, 2011; European Commission, 2016)); Moordijk, The Netherlands (€ 65,4 m (European Commission, 2016)). Despite the continuous growth of insurance capacity (European Commission, 2016) the sector itself is clearly unwilling to cover catastrophic damage (Insurance Europe, 2013). The analyses show that the average cost of remedying amounts to € 42 K. The average is calculated after the extreme events have been excluded – the few occurrences where the costs of remedying exceeded €1m. Member states have recorded five extreme events: two in Hungary and the Netherlands where the costs of remediation amounted to € 65 m, and three others – in Spain, Greece and Sweden – where the damage cost ranged between € 1m – € 10 m (European Commission, 2016).

Environmental risk insurability – exogenous approach

Not all local environmental insurance markets are working efficiently. The reasons for this situation should be sought within the exogenous indicators of insurability i.e. the ones which describe the attributes of the supply and demand sides of the market as well as its legal and political surroundings (the ability to control moral hazard and adverse selection; insurance capacity, determined primarily by insurers' capital resources, and also by legal requirements concerning the above).

Occurrence of moral hazard is a common problem of insurance companies, especially in liability insurance in the *actio directa* system. Controlling moral hazard is possible and efficient as long as it is allowed by the know-how and organisational qualities of the insurers, market-related expectations of insurers toward potential policyholders, market-verified environmental risk management standards and legal regulations¹¹. An essential way of controlling adverse selection, in turn, is tailoring the premium level to the individual risk profile of the protection-seeking entity. It is difficult because of a limited demand for environmental insurance, caused by poor insurance and environmental awareness.

It is worth emphasizing that it is often not the insurers who hinder the market development. The research conducted in 2014 by Insurance Europe points at a relatively high insurance capacity of the market. Liability insurance cover against environmental damage (in the scope defined by the ELD) is usually offered at the level of guaranteed sums from € 1 m to € 5 m. Insurance capacity in some markets, however, reaches far higher, up to € 50 m, and in some individual cases - even more (Insurance Europe, 2014). If one should set the capacity declared by insurers against the size of the environmental damage registered in Europe, it can be assumed that even in the case of catastrophic events (e.g. Kolontar, Hungary) it would have been possible to sign insurance contracts for sums close to the damage values. A great diversity in the markets is the crucial barrier: large insurance claims may be paid in Germany, France or Great Britain. Developing markets' capacity is still rather limited and barriers on the demand side are an obstacle to cross-border cover purchases. However, entities which seek to insure against large risks must be aware that insurers are not going to offer limitless cover for environmental damage, as its size can exceed the whole industry's capacity (Insurance Europe, 2013).

Public policy and the legal system, as subsequent insurability factors, increase the importance of environmental damage liability issues in the global scale. The concept of society's sustainable development is becoming a contemporary paradigm. Since 1987, when the notion of sustainable development (United Nations, 1987) was coined, it remains the benchmark for creation of societies' development strategy (European Commission, 2010; Decision No 1386/2013/EU). Legislations in particular countries have been gradually, but with a growing determination, introducing preventive and repressive measures as well as regulating the legal duty to remedy environmental damage.

A legal system which defines the notion of environmental damage and liability, pre-defines environmental risk. The doctrine points at two basic areas where certain traits of the legal

¹¹ E.g. the structure of the obligatory insurance system, which enables the insurer to refuse to supply insurance cover.

system generate greatest problems relating to covering environmental liability. These are: changeability (Ad-Hoc Industry Natural Resource Management Group, 2009) and regulatory transfer of uncertainty connected with the cause of environmental damage to the potential insured (Faure, 2001). Changeability refers to both the content of regulations and their interpretation. In the first case a risk which arises concerns retroactive change, i.e. introduction of obligation to remedy the damage which was not encompassed by obligation to be remedied at the time of insurance contract signing. In the other, a change in interpretation of laws leads to increasing polluters, and their insurers' environmental liability. In 2004 the ELD introduced an unprecedented – in most member countries – obligation to remedy damage inflicted on waters, protected species or natural habitats¹², and additionally included a requirement concerning preventive measures. The burden of both restoring the environment and rectifying so called functional damage is extremely challenging. In the first case, it may be very difficult to establish the initial state of the environment. In the other case, the steps taken should become the compensation for the fact that some elements of the environment cannot perform their functions (Ad-Hoc Industry Natural Resource Management Group, 2009). The relatively small number of occurrences which undergo the ELD regime still results in fairly high uncertainty as for their interpretation. This in turn causes the size of liability to be less predictable.

The transfer of uncertainty connected with the cause of environmental damage to the potential insured takes place under the risk-based liability regime. This is what the ELD includes when it comes to the obligation to remedy the damage caused by entities generating an increased probability thereof. Moving forward from the general rules (fault principle) to the risk principle is a factor which limits insurability. Uncertainty connected with the source of the environmental damage cause is assigned to the insured, and, consequently, their insurer as well. As a result, the latter has the obligation to pay the compensation even if the entity covered has not caused the damage (Faure, 2001).

4 Conclusions

If insurability were to be measured only according to the market accessibility of insurance cover for environmental risk, it would have to be categorised as insurable. Nevertheless, the assessment of environmental risk through the prism of doctrinal criteria of insurability indicate the low degree of insurability. What makes environmental risk less insurable than other risk categories is the difficulties with defining environmental risk as measureable, extraordinary and independent of one's will, followed by the fact that it often materialises as a catastrophe. The above is additionally exacerbated by instability in legislation and its interpretation as well as low insurance awareness. The few available research studies of environmental risk insurability have shown that in European countries no or insufficient insurance cover refers to damage done to protected species and natural habitats (juxtaposed with a relatively high level of insurance against water and soil pollution) as well as environment impairment caused either gradually or by activity for which permission has been previously granted. Also, significantly limited insurance offer covers activities related to new technologies or activities generating an increased threat of environmental damage (i.e. activities connected with GMO, nuclear power, waste management and the use of plant protection products in farming), (Bio Intelligence Service in association with Stevens&Bolton LLP, 2009; Swiss Re, 2007).

The analysis of the degree to which insurability criteria are met serves as the basis for creating an action catalogue for the state or a business sector in order to enhance it (e.g. building data bases, creating estimation models, raising legal and insurance awareness through educational projects). Such actions will most probably remain inefficient with regard to non-insurability of environmental damage resulting from regular (non-accidental) operations of business entities. Economic development will always generate environment impairment, partly an uninsurable one. The private insurance sector will not embark on

¹² The directive also imposes a duty to remedy the damage on the soil surface, but in this respect, most countries already had some regulatory experience.

covering catastrophic damage, either. Environmental risk management in this area must be focussed on instruments of preventive impact on the scope of potential damage.

Aknowledgments

This research was undertaken as part of the project: Private insurance and environmental management systems complying with ISO 14001 as tools of environmental risk's management - analysis of relations and was funded by a grant of National Science Centre, Poland (2016/23/D/HS4/02654)

References

- ACE Group (2011). *A Guide to Environmental Liability in Europe*. Retrieved from: https://www2.chubb.com/benelux-nl/_assets/documents/strategic-risk-guide-to-environmental-liability-in-europe.pdf
- Ad-Hoc Industry Natural Resource Management Group (2009). *Financial Security and Insurance Aspects of the European Union Environmental Liability Directive*. White Paper. Brussels.
- Berliner, B. (1985). Large risks and Limits of Insurability. *The Geneva Papers on Risk and Insurance*, vol. 10(37), p. 322.
- Berliner, B. (2011). *Limits of Insurability of Risks*. Prentice Hall.
- Biener, Ch., Eling, M., Wirfs, J.H. (2015). Insurability of Cyber Risk: An Empirical Analysis. *The Geneva Papers*, vol. 40, p. 138.
- Bio Intelligence Service in association with Stevens&Bolton LLP (2009). *Study on the Implementation Effectiveness of the Environmental Liability Directive (ELD) and Related Financial Security Issues*.
- Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020.
- Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.
- El Pais (2010). *El desastre que amenazó Doñana*. Retrieved from: http://elpais.com/diario/2010/10/06/sociedad/1286316006_850215.html.
- European Commission (2010). *Communication from the Commission, Europe 2020, A strategy for smart, sustainable and inclusive growth*. Brussels, COM (2010) 2020.
- European Commission (2016). REFIT Evaluation of the Environmental Liability Directive. *Commission Staff Working Document*, SWD (2016) 121 final.
- Faure, M. (2001). Environmental damage insurance in theory and practice. *Paper prepared for the law and economics of environmental policy: a symposium*, London.
- Faure, M. G., Grimeaud, D. (2000). *Financial Assurance Issues of Environmental Liability*. Maastricht: Maastricht University, European Centre for Tort and Insurance Law.
- Fedor, M. (2004). Series of scientific papers titled: Granice ubezpieczalności. *Gazeta Ubezpieczeniowa*.
- Guevara, D. L., Deveau, F. J. (2012). *Environmental Liability and Insurance Recovery*. Chicago, Illinois: ABA Publishing.
- Institute of Sustainable Development (2010). Environmental Liability Directive and Methods of Equivalency. *Evaluation & Integration*, vol. 19, after: Aon Risk Solutions (2011). A Business Guide to the European Union Environmental Liability Directive.
- Insurance Europe (2013). *Insurance Europe response to the European Commission's Green paper on Insurance of Natural and Man-made Disasters*. Position Paper.

- Insurance Europe (2014). *Survey of environmental liability insurance developments*. Briefing note.
- Knight, F. H. (1921) *Risk, Uncertainty, and Profit*. Boston: Hart, Schaffner & Marx; Houghton Mifflin Co.
- Kunreuther, H., Hogarth, R., Meszaros, J. (1993). Insurer Ambiguity and Market Failure. *Journal of Risk and Uncertainty*, pp. 71-87, after: Faure, M. (2001). Environmental damage insurance in theory and practice. *Paper prepared for The law and economics of environmental policy: a symposium*. London.
- Naylor, J., Dybdahl, D. J. (2012). *The History and Use of Environmental Insurance*. Retrieved from: www.armr.net.
- Outreville, J. F. (1997). *Theory and Practice of Insurance*. Springer Science+Business Media LLC.
- Rejda, G. E. (2014). *Principles of Risk Management and Insurance*, 12th ed. Pearson Global Edition.
- Swiss Re (2003). *The insurability of ecological damage*. Technical publishing Casualty.
- Swiss Re (2007). *Insuring environmental damage in the European Union*. Retrieved from: <http://www.swissre.com/library/111437999.html>
- Swiss Re (2009). Commercial liability: a challenge for businesses and their insurers. *Sigma*, vol. 5.
- Swiss Re (2017). Commercial insurance: innovating to expand the scope of insurability. *Sigma*, vol. 5.
- United Nations (1987). *United Nations General Assembly Report of the World Commission on Environment and Development*. Brundtland Report, A/RES/42/187. Retrieved from: www.un.org.
- Vaughan, E.J., Vaughan, T.M. (2008). *Fundamentals of Risk and Insurance*. 10th ed. John Wiley & Sons.

Assessment of Factors Influencing of Final Corporate Income Tax Liabilities in Selected Sectors in the Czech Republic

Karolina Lisztwanová¹, Iveta Ratmanová²

¹ VSB-TU Ostrava

Faculty of Economics, Department of Finance
Sokolská třída 33, 702 00 Ostrava, Czech Republic
E-mail: karolina.lisztwanova@vsb.cz

² VSB-TU Ostrava

Faculty of Economics, Department of Finance
Sokolská třída 33, 702 00 Ostrava, Czech Republic
E-mail: iveta.ratmanova@vsb.cz

Abstract: *The Czech government uses corporate taxation to support desirable corporates' behaviour, for example the willingness to invest or the elimination of impact of corporates' risk etc. The object of the paper is to assess the impact of changes of the statutory tax rate, to emphasize the impact of the items reducing tax base and the influence of the tax discounts on the total tax liability. First of all, main attention is devoted to the evaluation of the impact of tax losses, research and development expenses, expenses connected with donation activities and investment incentives of the selected sectors during period 2005-2016 with using data provided by Ministry of Finance of the Czech Republic. The method of pyramidal decomposition of the final tax liability is used, so that we could state and compare the changes of above-mentioned items moreover functional method is applied in case of identification of multiplicative relationship among defined individual items. As far as our results are concerned, we are able to emphasize the items that influenced the changes of the corporate income tax liability of the selected sectors the most. We can state that the changes of the individual adjustments of tax base are the most significant in the case of all sectors, but on the other hand, when it comes to the rest of the items their impact differs.*

Keywords: *corporate income tax, tax base, pyramidal decomposition, functional method, individual sectors*

JEL codes: *H20, G30, K34, H25, G39*

1 Introduction

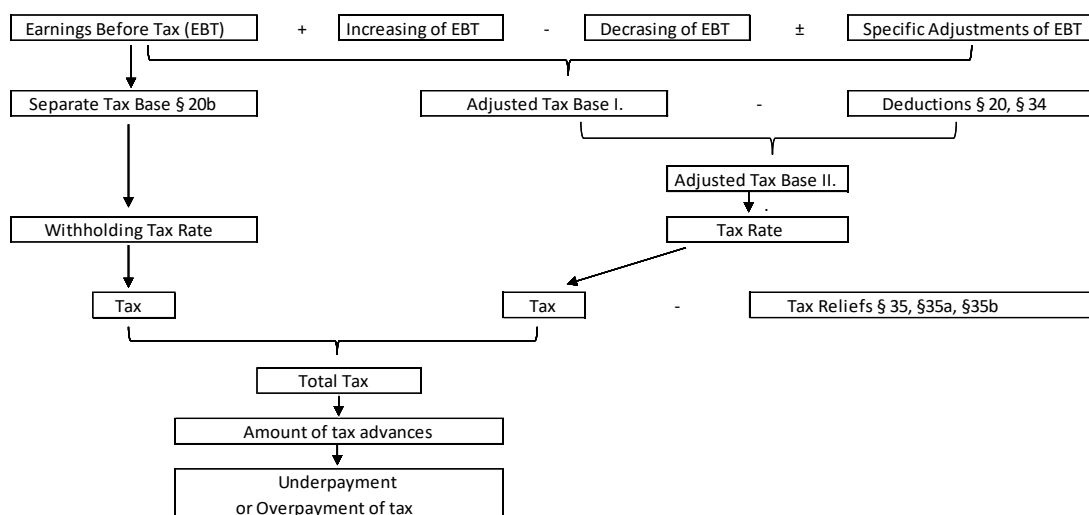
Direct taxation is closely tied with taxpayers' income. Corporate income tax as one kind of direct taxes uses this fact in order not only to create governments' tax revenues, but to support desirable activities or behaviour of individual enterprises too. Among activities, which can be in the centre of tax policy interests, we can include e.g. research and development expenses, elimination of impact of tax losses, gratuitous transactions and reliefs decreasing final tax.

Generally, it can be claimed that it is necessary to know value of corporate's accounting profit or difference between incomes and expenses to determine final tax. However, in most countries the way, how to calculate final tax is not so simple. Because of this, not all corporate's revenues and not all corporate's expenses may influence total tax. There are some specific kinds of revenues, which should be excluded from total sum of revenues and there are some other specific kinds of expenses which must not influence final tax or which may be taken into account only respecting certain limit. Moreover, countries exist, which use different other kind of tax base and not only income decreased with expenses.

In the case of the Czech Republic, processing of assessment of final tax is derived, first of all from accounting profit i.e. from difference between income and expenses, which are adjusted respecting if they are or not being recognized as taxable. Detail of their assessment must respect information of section mark 23, 24 and 25 of The Act. 586/1992

Coll., on Income Taxes. The following figure briefly summarizes the prevailing structure of the tax calculation in practice.

Figure 1 Structure of tax calculation and settlement of tax liability



Source: Authors' processing according data of the Act no. 586/1992 Coll., on Income Taxes

Regarding the previous figure 1 amounts, which are able to increase or to decrease profit or loss influence determining of tax base possibly of tax loss. Deductions pursuant to section mark 20 or 34 moreover reduce tax base. In addition, the final tax is calculated respecting tax rate and tax reliefs. Moreover, it is clear from the figure that the certain part of the tax base exists which is taxed separately with withholding tax rate.

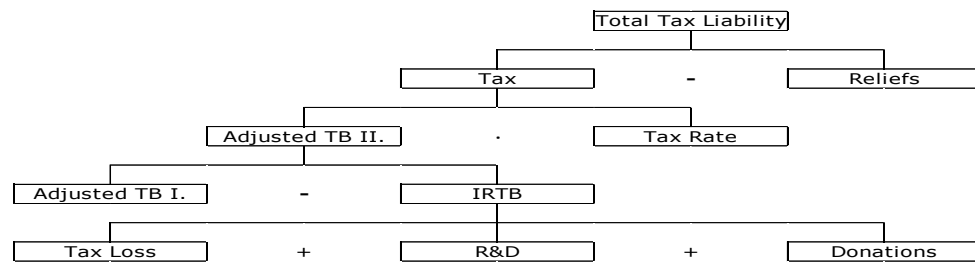
As it can be seen, there are many facts, which can influence the final total tax. It is clear, if data are available, it is not problem to identify value of these facts. If their value is known, it is not problem to assess their impact on the total tax too. The impact of individual items influencing value of the total tax respecting total corporates' data between years 2005 - 2015 have been already made (Lisztwanová, Ratmanová, 2017). The goal of this paper is to concentrate on determining and assessment corporates' tax data with regard to individual selected sectors during period 2005 - 2016 and to identify the impact of indicators on changes of the total tax. The length of the observed period was chosen with regard to data availability.

2 Methodology and Data

It would be certainly interesting to find out, how individual adjustments, deductions and reliefs influenced the final tax of corporates and their development in time. Of course, the very easy way, how to evaluate their impact, it is to calculate their ratio to the total tax value. Notwithstanding, determination of above-mentioned impact will be stated with analysis of variances which can be considered to be more sophisticated process. In addition, it can be said that the analysis of variances is applied, if there is possibility to identify data during certain period and if partial components of analysed item exist.

If the total final tax is considered to be the top indicator, relationships among individual items influencing the total tax can be described with the way mentioned in figure 2 (Lisztwanová, Ratmanová, 2017). It is clear that figure 2 should be similar to figure 1. Nevertheless, figure 2 brings the possibility to emphasize the impact of selected corrections of the tax base with section mark 20 and 34 of The Act. 586/1992 on the final tax. Above that, the final form of the created pyramidal decomposition corresponds to the structure of the available data. Generally, it can be claimed that is possible to identify decomposition of the total tax and to calculate power of influence of individual indicators. It means that changing of the top indicator can be explained with changes of individual items where individual relationships are expressed mathematically.

Figure 2 Pyramidal decomposition of total tax liability



Source: Authors` processing according data of Finanční správa

When it comes to the detail of figure 2 it is clear that mathematical expression of individual relationships among indicators can be stated through additive or multiplicative operation. In the case of additive operation, the following formula can be determined

$$\Delta x_{a_i} = \frac{\Delta a_i}{\sum_i \Delta a_i} \cdot \Delta y_x, \quad (1)$$

where $\Delta a_i = a_{i,1} - a_{i,0}$, $a_{i,0}$, and $a_{i,1}$ is the value of the indicator i respecting starting (0) and ending (1) state.

Referring to (Lisztwanová, Ratmanová, 2017) the multiplicative operations can be calculated with the functional method, which expresses the combined simultaneous impact of the all indicators explaining their influence on the top indicator (Zmeškal, Dluhošová, Tichý, 2004). Respecting the multiplicative operation between two indicators, the influences can be formulated as

$$\Delta x_{a_1} = \frac{1}{R_x} \cdot R_{a_1} \cdot \left(1 + \frac{1}{2} \cdot R_{a_2}\right) \cdot \Delta y_x, \quad (2)$$

$$\Delta x_{a_2} = \frac{1}{R_x} \cdot R_{a_2} \cdot \left(1 + \frac{1}{2} \cdot R_{a_1}\right) \cdot \Delta y_x. \quad (3)$$

where R_{a_i} and R_x are relative changes of indicators.

So that one could assess the impact of individual components of the final tax as the top indicator of the pyramidal decomposition, we used data provided by Finanční správa that provides annual value of the earnings before taxation (EBT), the tax base, and the items reducing tax base, the tax reliefs and the final total tax.

3 Assessment of Impact of Indicators of Selected Sectors

Concerning the total corporates` tax data, the final power of impact of above-mentioned

Table 1 Total power of influences of individual indicators

	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	Sum	% of sum	Order
	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK		
ΔTTL	17,662	23,335	19,143	27,202	-2,928	-1,203	1,512	5,300	11,206	11,326	7,191			
Reliefs	731	820	1,994	129	902	732	1,569	9,672	689	10,206	105	27,550	12,11	4
STR	11,112	0	21,481	6,664	6,268	0	0	0	0	0	0.000	45,525	20,01	2
ATB I.	26,392	22,169	6,700	20,921	3,466	3,942	2,524	18,514	8,835	1,623	6,791	121,875	53,56	1
Tax Loss	3,449	2,202	6,465	308	1,137	3,829	5,723	2,979	3,000	223	363	29,679	13,04	3
R&D	249	215	87	60	345	549	120	359	56	273	177	2,492	1,10	5
Donations	87	0.21	21	6	15	35	3	204	4	7	35	418	0,18	6
	227,538													

Source: Authors` calculation according data of Finanční správa

indicators on the total tax has been already defined (Lisztwanová, Ratmanová, 2017). Table 1 presents these findings. The changes of data between individual periods, the total tax as the topic indicator of pyramidal decomposition and analysis of variances have been used to determine impact of changes of individual indicators on the top indicator. Respecting the way of processing and concerning on data of the last column of the table 1, it is clear which changes affected the most the development of the total tax. It was adjusted tax base I. On the contrary, the changes of donations caused changes of total tax at least in the selected periods. The following table 2 contains value of changes of the total tax with regard to selected sectors. The main attention has been concentrated on following sectors: agriculture (A), mining and quarrying (B), processing industry (C), production and distribution of electricity (D), construction sector (F) and finance and insurance sector (K). The sectoral designation with individual letters corresponds to the designation used by the financial administration of the Czech Republic.

Table 2 Change of total tax liability according selected sectors

	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16
	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK
Sector A	216.5	278.5	-159.3	-527.9	772.4	1,031.6	100.4	284.5	721.7	-658.3	-43.4
Sector B	-17.6	487.1	325.8	-2,276.1	1,105.9	165.6	-1,320.3	396.2	-600.7	108.1	-753.2
Sector C	1,360.8	10,425.9	-11,511.7	-12,887.9	4,235.4	452.9	1,356.3	1,534.6	11,573.0	3,581.2	4,519.5
Sector D	5,202.1	1,043.4	2,675.5	-735.8	-929.2	-3,199.2	2,905.6	-947.8	-2,663.4	-435.0	513.4
Sector F	839.3	1,259.1	-1,016.4	-673.5	-427.8	-1,737.0	-621.0	241.9	178.6	1,881.5	9.2
Sector K	-1,042.5	2,175.1	-3,579.5	2,212.9	-3,722.6	1,366.4	4,848.4	-798.5	284.9	1,711.6	-1,162.4

Source: Authors` calculation according data of Finanční správa

Because it is obvious, that changes of the total tax differ among individual sectors, data of selected sectors respecting period between years 2005 – 2016 have been tested. The way of processing was the same as of data for all businesses respecting created pyramidal decomposition and using analysis of indicators variances between years. In the following text, sector findings are always presented with two ways. First, information in mil. CZK expresses value, which caused increasing or decreasing of the total tax between two periods. It is clear that changes of the total tax liability were not only influenced with increasing of all items. It means that changes of indicators` influences could be positive or negative. Although, in order to determine the overall ranking of impacts of individual indicators, their absolute values have been used. This information can also be presented as the absolute value of individual indicators for the individual sector. Similarly, as in the table 1 information about final rank of individual indicators, respecting sectoral data are added. Thanks to this, it is easy to determine and later to compare results of selected sectors to each other.

Table 3 Total power of influences of individual indicators of agriculture sector A

	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	Sum	% of sum	Order
	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK		
Reliefs	5,279	5,279	5,279	5,279	5,279	5,279	5,279	5,279	5,279	5,279	5,279	58,073	0,86	4
STR	119,311	0,000	241,009	70,347	80,827	0,000	0,000	0,000	0,000	0,000	0,000	511,494	7,53	3
ATB I.	334,934	476,641	150,674	508,940	1 006,186	1 093,595	20,266	225,563	735,661	706,465	23,862	5 282,787	77,79	1
Tax Loss	9,284	172,496	216,568	34,232	147,686	67,002	116,653	60,077	8,052	48,181	20,215	900,446	13,26	2
R&D	1,198	3,685	3,747	0,518	0,133	1,066	0,643	0,812	1,824	2,517	3,213	19,355	0,29	5
Donations	1,970	4,051	1,722	2,724	1,176	0,523	0,463	2,162	2,247	1,114	0,570	18,723	0,28	6
												6 790,877		

Source: Authors` calculation according data of Finanční správa

According to data of the first sector – agriculture it can be seen that individual adjustments of tax base I. influenced the total tax of corporates the most. The tax loss was the following indicator that influenced observed changes the most. Vice versa, the impact of donations was the least.

When it comes to the sector of mining and quarrying, it was observed the same result as in the case of the agriculture sector. The biggest influence of ATB I.. The expenses connected with research and development t caused changes of the total tax liability the leas. Surprisingly, changes of statutory tax rate brought changes of the final tax about in the second rank.

Table 4 Total power of influences of individual indicators of sector of mining and quarrying B

	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	Sum	% of sum	Order
	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK		
Reliefs	2,353	2,377	2,215	1,237	0,347	0,896	4,098	0,356	1,118	0,936	0,273	16,205	0,16	5
STR	285,194	0,000	563,424	155,775	135,879	0,000	0,000	0,000	0,000	0,000	0,000	1 140,272	11,48	2
ATB I.	228,510	499,313	901,865	2 116,057	1 214,764	181,889	1 349,011	401,614	599,317	188,069	644,648	8 325,057	83,84	1
Tax Loss	43,470	17,332	5,700	8,446	23,300	22,105	9,189	2,332	2,560	84,091	112,887	331,414	3,34	3
R&D	0,045	0,029	0,015	0,059	0,137	0,018	0,058	2,815	1,355	0,955	1,373	6,858	0,07	6
Donations	6,718	2,686	9,188	2,926	3,895	39,354	33,718	0,627	0,905	4,102	5,411	109,530	1,10	4
												9 929,336		

Source: Authors` calculation according data of Finanční správa

Judging the impact of indicator that defines changes of the total tax in the case of processing industry it was verified the most important role of individual adjustments of tax base I. too. For the second time one can see, that the individual reliefs followed indicator ATB I. in influencing of the total tax. The indicator with the least impact is the same as in case of agriculture sector, i. e. donations influenced changes of the total tax the least.

Table 5 Total power of influences of individual indicators of processing industry C

	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	Sum	% of sum	Order
	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK		
Reliefs	922,600	501,501	1 996,656	151,628	818,572	960,508	1 579,082	2 212,027	2 213,781	661,642	19,004	12 037,002	11,48	2
STR	3 042,872	0,000	5 731,350	1 455,081	1 336,389	0,000	0,000	0,000	0,000	0,000	0,000	11 565,692	11,03	3
ATB I.	5 889,013	10 723,455	8 924,789	11 096,440	8 603,456	1 091,781	1 839,875	470,506	15 003,251	3 639,962	3 344,885	70 627,414	67,36	1
Tax Loss	398,337	191,189	1 166,825	558,197	1 876,418	593,081	1 185,453	2,254	1 187,255	751,175	1 064,204	8 974,388	8,56	4
R&D	114,335	15,897	32,253	36,665	327,061	253,368	99,068	204,793	24,138	161,872	140,005	1 409,455	1,34	5
Donations	50,071	28,696	13,236	33,543	9,640	18,114	9,165	0,170	53,332	13,626	10,574	240,168	0,23	6
												104 854,117		

Source: Authors` calculation according data of Finanční správa

The sector of production and distribution of electricity does not differ from previous sectors. Individual adjustments played significant role in determining of changes of the total tax liabilities. Nevertheless, one can identify for the second time the important impact of the tax loss generated by corporates of this sector. Surprisingly, respecting the observed period, this sector is associated with the least impact of expenses on research and development.

Table 6 Total power of influences of individual indicators of sector of production and distribution of electricity D

	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	Sum	% of sum	Order
	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK		
Reliefs	1,297	1,488	1,546	0,430	0,349	1,540	0,981	0,780	1,077	0,186	0,317	9,990	0,024	5
STR	772,534	0,000	1 956,110	755,415	751,354	0,000	0,000	0,000	0,000	0,000	0,000	4 235,414	10,174	3
ATB I.	6 036,184	994,079	4 742,141	102,426	318,348	3 206,311	2 890,840	2 697,786	5 983,323	550,410	1 305,705	28 827,553	69,248	1
Tax Loss	59,820	26,848	118,143	56,691	160,902	24,714	36,115	3 656,317	3 332,180	101,760	800,787	8 374,277	20,116	2
R&D	1,033	0,034	0,117	0,021	1,227	0,871	0,474	1,938	0,937	0,643	2,165	9,460	0,023	6
Donations	4,101	21,054	5,909	25,656	18,787	29,432	19,925	11,881	12,118	12,820	10,948	172,630	0,415	4
												41 629,325		

Source: Authors` calculation according data of Finanční správa

Regarding the calculation and data of table 7, it can be confirmed that ATB I. the most influenced changes of the total tax followed with changes of the statutory tax rate in the case of the construction sector. Vice versa, this one is the sector with the least impact of donations activities on the final tax and it is the same as in the case of processing industry.

Table 7 Total power of influences of individual indicators of sector of construction sec. F

	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	Sum	% of sum	Order
	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK		
Reliefs	25,608	20,000	10,316	162,871	103,519	6,335	115,845	4,374	6,007	1,761	0,052	456,689	3,56	4
STR	540,629	0,000	1 057,191	349,137	340,301	0,000	0,000	0,000	0,000	0,000	0,000	2 287,257	17,83	2
ATB I.	1 595,329	1 235,412	121,974	72,400	155,641	1 672,865	787,016	337,722	342,929	2 027,653	197,144	8 546,086	66,64	1
Tax Loss	135,204	108,735	80,099	22,685	73,887	34,046	19,975	108,620	174,923	139,809	210,080	1 108,062	8,64	3
R&D	46,219	62,684	76,472	67,051	38,485	43,732	26,388	6,279	18,659	0,242	0,610	386,822	3,02	5
Donations	8,394	2,384	4,114	0,685	0,029	7,258	3,846	2,098	2,091	4,795	4,348	40,043	0,31	6
												12 824,959		

Source: Authors` calculation according data of Finanční správa

Even in the latter case we can identify adjustment of tax base I. as the indicator which the most changed the total tax liability of finance and insurance enterprises. The tax loss is the indicator with the second rank in assessing indicators and regarding expenses of research and development, it can be observed the least impact on the total tax in selected periods.

Table 8 Total power of influences of individual indicators of finance and insurance sec.K

	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	Sum	% of sum	Order
	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK	mil. CZK		
Reliefs	96,302	6,320	50,185	25,349	7,712	25,888	0,039	12 067,365	1 289,760	10 773,281	2,760	24 344,961	20,54	3
STR	1 258,895	0,000	2 071,006	729,066	723,095	0,000	0,000	0,000	0,000	0,000	0,000	4 782,062	4,03	4
ATB I.	5 420,789	1 622,054	4 987,609	2 994,045	8 097,862	7 787,080	399,142	12 125,904	3 119,177	9 024,365	893,916	56 471,942	47,64	1
Tax Loss	5 528,149	563,820	6 454,254	38,717	5 074,876	6 334,863	5 275,074	703,392	1 944,701	50,520	291,093	32 259,458	27,22	2
R&D	2,092	2,816	4,327	13,853	2,684	105,899	6,365	38,759	8,351	13,772	7,304	206,222	0,17	6
Donations	14,777	7,270	12,712	24,894	13,125	5,822	21,214	192,412	161,274	0,562	12,528	466,590	0,39	5
												118 531,234		

Source: Authors` calculation according data of Finanční správa

4 Conclusions

The following table 9 provides summarized information about the power of influences of individual indicators respecting data of selected sectors. Generally, it can be claimed that, thanks to methods of the pyramidal decomposition and thanks to the analysis of variances, it has been verified respecting input data that individual adjustments of the tax base I. affected changes of the corporates` final tax regarding selected sectors the most. The influence of changes in rates of the statutory tax itself cannot be overlooked either. Comparing individual sectors, it can be confirmed that reliefs play the most important role in the case of the processing industry. The agriculture, the sector of production and distribution of electricity and the finance and insurance sector are sectors with the important influence of the tax loss in observed period. Expenses of research and development affected situation of the agriculture sector, the processing industry and of the construction sector the most. The last one – the gratuitous activities play important role in changes of the total tax during period 2005- 2016 in the case of the sector of mining and quarrying and in the sector of production and distribution of electricity.

Table 9 Ranking of indicators' impacts in individual sectors

	Sector A	Sector B	Sector C	Sector D	Sector F	Sector K
Reliefs	4	5	2	5	4	3
STR	3	2	3	3	2	4
ATB I.	1	1	1	1	1	1
Tax Loss	2	3	4	2	3	2
R&D	5	6	5	6	5	6
Donations	6	4	6	4	6	5

Source: Authors` calculation according data of Finanční správa

In addition to determining the absolute magnitude of the influence, the direction of this influence can be assessed and compared too. This direction is presented in table 10. It is clear that the frequency of occurrences of the effect of increasing or decreasing the overall tax burden within the sectors between the various items has been identified.

Regarding the influence of the statutory tax rate, it can be only observed decreasing impact. Generally, it can be claimed, that decreasing of statutory tax rate causes decreasing of the total tax liability of all sectors. The impact of the rest of indicators were so unequivocal. However, in most cases, the indicator adjusted tax base I. has contributed to the increasing of the tax burden for individual sectors. The tax loss contributed to reduction in the year-on-year tax burden on the sectors in most cases; surprisingly in the case of the agriculture and processing industry, the tax loss was more likely to increase the tax change. As regards to the impact of changes of research and development expenditures and their impact on changes in overall tax liability for individual sectors, no clear impact on the increase or decrease it has been demonstrated with usage of methods

of pyramidal decomposition and analysis of variances. However, results of individual sectors, in the case of the agriculture sector can be confirmed that if the total tax increases, research and development expenditures reduce this increasing. Unfortunately, this unambiguous relationship cannot be confirmed for other sectors. When it comes to donations as the indicator which changes influenced development of the sector's total tax, this one more often contributed to reduction of the sector's tax liability. The last factor - reliefs - generally can be confirmed that except the processing industry, this one decreased the total sector's tax.

Table 10 Frequency of direction of influence of indicators' impacts on individual sectors

	Sector A		Sector B		Sector C		Sector D		Sector F		Sector K	
	-	+	-	+	-	+	-	+	-	+	-	+
Reliefs	6	5	9	2	3	8	6	5	6	5	8	3
STR	4	0	4	0	4	0	4	0	4	0	4	0
ATB I.	5	6	4	5	3	8	4	7	6	5	6	5
Tax Loss	5	6	8	3	5	6	6	5	7	4	6	5
R&D	7	4	4	7	8	3	6	5	4	7	5	6
Donations	8	3	4	7	5	6	5	6	6	5	6	5

Source: Authors' calculation according data of Finanční správa

In conclusion, it has been verified the possibility to determine factors influencing the final tax of corporates of the individual selected sectors through the usage of the pyramidal decomposition method with regard to the selected top indicator. Moreover, it has been verified that analysis of variances can be used to determine power of impact of individual indicators of the pyramidal decomposition on the final total tax. Last but not least, with regard to the real data of selected sectors for the certain period, factors that most or the least affected the change of the tax liability were identified. However, with regard to the input data, it was unreservedly confirmed with the analysis of the variances that tax-deductible items or tax reliefs have always contributed to the tax reduction.

Acknowledgments

This paper was supported by the SGS Project VŠB – TU Ostrava SP2018/154 "Finanční rozhodování podniků a finančních institucí za rizika".

References

Act no. 586/1992 Coll., on Income Taxes, as amended.

Dluhošová, D., Zmeškal, Z., Richtarová, D., Valecký, J. (2010). *Finanční řízení a rozhodování podniku*. 3th ed. Praha: Ekopress.

Finanční správa (2017). *Analýzy a statistiky: Daňová statistika k roku 2005-2015*. Retrieved from: <http://www.financnisprava.cz/cs/dane/analyzy-a-statistiky/danova-statistika>.

Finanční správa (2017). *Údaje z výběru daní: Vývoj inkasa vybraných daní v ČR v letech 1993-2016*. Retrieved from: <http://www.financnisprava.cz/cs/dane/analyzy-a-statistiky/udaje-z-vyberu-dani>.

Kubátová, K. (2015). *Daňová teorie a politika*, 6th ed. Praha: Wolters Kluwer.

Lisztwanová, K., Ratmanová, I. (2017). Assessment of Impact of Items Reducing Tax Base and Tax on Total Amount of Corporate Income Tax in the Czech Republic in Selected Periods. In: *Proceedings of the 14th International Scientific Conference European Financial Systems 2017*. Brno: Masaryk University, pp. 498-507. ISBN 978-80210-8609-8.

OECD (2017). *Tax on corporate profits*. Retrieved from: <https://data.oecd.org/tax/tax-on-corporate-profits.htm#indicator-chart>.

Široký, J. (2008). *Daňová teorie s praktickou aplikací*. 2nd ed. Praha: C. H. Beck.

Zmeškal, Z., Dluhošová, D., Tichý, T. (2004). *Financial Models*. 1st English ed. Ostrava: VSB-Technical University of Ostrava, Faculty of Economics.

Financial Performance of Czech Privately-Held Firms with Multiple Owners

Ondřej Machek¹, Aleš Kubíček²

¹ University of Economics, Prague
Faculty of Business Administration, Department of Strategy
nam. W. Churchilla 4, 13067 Prague 3, Czech Republic
E-mail: ondrej.machek@vse.cz

² University of Economics, Prague
Faculty of Business Administration, Department of Strategy
nam. W. Churchilla 4, 13067 Prague 3, Czech Republic
E-mail: ales.kubicek@vse.cz

Abstract: *Privately-held firms represent the vast majority of firms worldwide. When owned by multiple shareholders, the owners become a social group who interact with each other, which affects the behavior of the firm and its financial performance. The goal of this paper is to explore the financial characteristics of Czech privately-held firms with multiple owners. Using a sample of 28,972 Czech limited liability firms, and after controlling for firm size, age, and industry affiliation, we found that the presence of multiple owners has a negative effect on asset turnover. However, the number of shareholders as such seems to have no effect on profitability, debt use, and liquidity. Instead, sole proprietorships seem to be empirically different from firms with two or more owners, as they have a significantly greater liquidity.*

Keywords: *multiple owners, performance, privately-held firms, Czech Republic*

JEL codes: *M10, G34*

1 Introduction

The relationship between ownership structure and financial performance has been subject to many studies over the last few decades. The existing body of research focused primarily on structural aspects, such as ownership concentration, the proportion of family owners, the proportion of institutional, private, government ownership, as well as the number of owners (Uhlener et al., 2015).

Most of the existing research on corporate governance has been carried out in countries with strong legal protection and developed financial markets. The existing studies focused mostly on publicly listed firms (McCahery and Vermeulen, 2010) and in corporate governance research, a particular emphasis has been placed on the relationship between ownership structure and performance; however, the studies presented inconsistent results (Uhlener, 2008).

Although publicly traded firms are important players in the global business, privately-held firms represent the vast majority of firms worldwide. This form of businesses encompasses all possible kinds of firms, including small family-run businesses, but also large international corporations, joint ventures, etc.

Agency theory assumes divergence of interests between owners and managers because of the separation of ownership from control. Managers pursue their self-interests (Jensen and Meckling, 1992), which creates the potential for management's opportunism and leads to agency costs. Hence, agency theorists proposed mechanisms that can protect shareholders against management's opportunism.

In publicly listed firms, governance is mostly formal (contractual), whereas in privately-held firms, governance becomes relational (Mustakallio et al., 2002). Hence, the findings on corporate governance in publicly traded firms cannot be simply applied to privately-held firms.

Moreover, it can be assumed that privately-held companies are also heterogeneous regarding governance mechanisms. Firms with a smaller number of owners, especially those owned by the same family, will rely more on informal (relational) governance mechanisms than firms with more dispersed ownership (Nordqvist et al., 2014; Uhlaner et al., 2007). It is no wonder that recent authors emphasized the need for studying the owning groups in corporate governance. This need is even more important when we realize that business-owning groups are a worldwide phenomenon; according to Uhlaner (2008), excluding publicly-traded firms, nearly half of all firms are owned by two or more people.

When multiple owners are present in a firm, they become a social group of people who "are aware of, interact with, and influence each other" (Uhlaner, 2008). The dynamics of owning group is assumed to affect the behavior of firms and their performance. Due to data unavailability, it is extremely difficult to study the dynamics of owning groups per se; however, existing databases allow for studying the effect of number of owners on various dimensions of financial performance. The goal of this paper is to explore the effects of the number of shareholders on financial ratios (profitability, liquidity, asset management and debt use) of Czech privately-held firms.

In past studies, the number of owners has often been used as a measure of ownership dispersion or firm size. The academic literature presents several findings on financial characteristics of single-owned firms and firms with multiple owners.

As to the relationship between the number of shareholders and profitability, the literature presents inconsistent evidence. A larger number of owners may result in higher agency costs, but at the same time, profit maximization may require a diffused ownership structure (Demsetz, 1983). Steijvers et al. (2006) found that in family firms, the number of owners had a positive effect on performance if the largest shareholder has an ownership share between 45% and 60%. On the other hand, a later study by Lappalainen and Niskanen (2012) found that an increase in the number of owners reduced firm profitability. Performance may also be measured using asset management ratios, such as asset turnover. This financial ratio has often been used as an inverse proxy for agency costs (Singh and Davidson, 2003; Fleming et al., 2005). In this context, Florackis (2008) found that larger UK firms had a lower asset turnover than small firms.

As the ownership becomes dispersed, the free-rider problem can occur. While few shareholders will have a strong incentive to incur the costs of management monitoring, in larger owning groups, individual shareholders will be less active. Limited monitoring will result in higher agency costs (Ang et al., 2000). Hence, we expect that increasing agency costs will result in worse performance, in particular:

H1: The number of owners negatively affects profitability.

H2: The number of owners negatively affects asset turnover.

Dalbor et al. (2004) found that the number of owners was positively associated with the amount of total debt in small restaurant firms. Similarly, Newman et al. (2013) found that single-owner SMEs had a lower propensity to take on total debt than SMEs with multiple owners. The idea that firms with multiple owners use more debt financing can be justified by several reasons. First, larger firms are more likely to have better access to external financing. On the other hand, smaller firms without formal governance mechanisms are likely to rely on internal financing (Young et al., 2008). Second, using increasingly more debt increases the risk of financial distress. Small firms are often more averse to risk, because their personal wealth, as well as the wealth of their owners' families, is directly connected to the success of their firm; also, small business owners want to avoid the loss of control over their firms (Mishra and McConaughy, 1999). Hence, we hypothesize that:

H3: The number of owners positively affects the level of debt.

We found no study evaluating the effect of the number of owners on firm liquidity (the ability to settle short-term liabilities). However, it can be assumed that larger firms, which are more likely to have multiple owners, are less risk-averse (Misra et al., 2005); a more aggressive financial policy can lead to keeping less amount of liquid assets, thus making

firms with multiple owners adopt a riskier, but potentially more profitable position. Therefore, we expect that:

H4: The number of owners negatively affects liquidity.

As far as we know, no similar study has been carried out in the Czech Republic. Several authors focused on the relationship between ownership concentration and performance (Konečný and Částek, 2016; Machek and Kubíček, 2018). In this paper, we are not interested in the effects of the amount of stock owned by individual investors, but in the number of owners, which is a straightforward indicator of the size and complexity of owning groups.

The rest of this paper is structured as follows. We present the methodology and data used in this study. Then, we present and discuss the results. Finally, concluding remarks are presented.

2 Data and Methodology

To get financial data on privately-held firms, we used the Bureau van Dijk's Amadeus database. We selected all Czech limited liability firms (s.r.o.) with one or more known shareholders, and with known data on the relevant financial ratios. To eliminate subsidiaries of foreign firms, we selected only firms located in the Czech Republic, who are owned by one or more named individuals or families, owning together between 50% and 100%. The final sample contains 28,972 firms and financial data for 2014-2016. Table 1 presents the industry affiliation of firms in the sample.

Table 1 Industry Affiliation of Firms in the Sample

Industry name (abbreviated)	Number of firms	Relative frequency
Agriculture, forestry, fishing, mining, quarrying	812	2.80%
Manufacturing	4,747	16.38%
Electricity, gas, steam, air conditioning, water supply, sewerage, waste management	437	1.51%
Construction	3,527	12.17%
Wholesale and retail trade; repair of motor vehicles and motorcycles	7,539	26.02%
Transportation and storage	1,091	3.77%
Accommodation and food service activities	766	2.64%
Information and communication	1,295	4.47%
Real estate activities	1,611	5.56%
Professional, scientific and technical activities	3,978	13.73%
Administrative and support service activities	838	2.89%
Other	2,331	8.05%
Total	28,972	100.00%

Source: Own analysis based on Bureau van Dijk's Amadeus database

To test the effect of the presence of multiple owners on financial performance, we employed correlation and linear regression analysis performed in Stata 14.

There are four models with four explained variables:

- Return on equity (net income over shareholder's funds) as a measure of profitability.
- Asset turnover (total sales over total assets) as a measure of asset management efficiency.
- Gearing (liabilities over equity) as a measure of financial leverage (level of debt).
- Current ratio (current assets over current liabilities) as a measure of liquidity.

The main explanatory variable is the number of owners. Besides that, we control for industry affiliation using eleven dummy variables (since financial characteristics differ

across industries). The analysis also controls for firm size as measured by the natural logarithm of total assets (to capture size-related effects such as returns to scale), and firm age since the date of incorporation (to capture maturation effects).

Standard regression diagnostics were applied. Possible multicollinearity has been evaluated using the variance inflation factors (VIF). However, no serious issues have been found. In all four models, means of residuals are very close to zero. Because according to the Breusch-Pagan test, the models are heteroskedastic, we used regression with robust standard errors. Finally, according to the Durbin-Watson test, there is no evidence of autocorrelation in our data.

It also makes sense to compare sole proprietorships (firms owned by a single shareholder) with firms owned by two or more shareholders. For this purpose, Student's t-test with unequal variances was used.

3 Results and Discussion

Table 2 present the descriptive statistics for the individual dependent and independent variables.

Table 2 Descriptive Statistics

	Mean	Standard deviation
Number of owners	1.752	1.370
Firm age	12.994	7.147
Firm size (ln of total assets)	5.166	1.705
Return on equity (ROE)	16.114	35.252
Asset turnover (AT)	5.674	12.825
Current ratio (CR)	5.317	7.887
Gearing (GE)	47.281	95.804

Source: Own analysis based on Bureau van Dijk's Amadeus database

As to the number of owners, there are 15,187 sole proprietorships, 9,620 firms are owned by two owners, and 2,623 firms are owned by three owners. Many firms are also owned by four owners (883), five owners (309) and six owners (115). The number of firms owned by more than six owners is rapidly decreasing.

Table 3 present the Pearson correlation coefficients between the dependent and independent variables. The correlation analysis suggests there is a negative bivariate linear relationship between the number of owners and firm age and size (both significant at the 0.01 level), but also a negative relationship between the number of owners and profitability and asset turnover (significant at the 0.01 level). No significant correlation between the number of owners and liquidity/use of debt has been found.

Table 3 Correlation Matrix

	Owners	Age	Size	ROE	AT	CR	GE
Owners	1						
Age	.181**	1					
Size	.061**	.361**	1				
ROE	-.015**	-.149**	.067**	1			
AT	-.040**	-.089**	-.041**	.016**	1		
CR	-.007	-.019	-.168**	-.036**	-.159**	1	
GE	.002	-.051**	.170**	-.019**	.065**	-.122**	1

Note: ** - significant at 0.05, Owners = number of owners, Age = firm age, Size = firm size, ROE = return on equity, AT = asset turnover, CR = current ratio, GE = gearing

Source: Own analysis based on Bureau van Dijk's Amadeus database

Table 4 displays the regression results for four models with different response variables. The results support the hypothesis that the number of owners in a firm has a negative

effect on asset turnover (significant at the 0.05 level). Contrarily to what we expected, return on equity, current ratio and level of debt seem to be unaffected by the number of owners.

Table 4 Regression Results

Dependent variable	Return on equity	Asset turnover	Current ratio	Gearing
Intercept	10.185**	67.653**	9.272**	43.314**
Number of owners	.029	-.139**	.057	-.793
Size	3.160**	-.188**	-.821**	11.199**
Age	-.922**	-.159**	.052**	-1.696**

Note: * - significant at 0.1, ** - significant at 0.05.

Industry dummies are not displayed.

Source: Own analysis based on Bureau van Dijk's Amadeus database

To compare firms with one owner with firms with multiple owners, Table 5 displays the results of Student's t-test with unequal variances. There are 15,187 firms with one owner and 13,785 firms with multiple owners in the sample. Significant differences have been found in terms of asset turnover and current ratio (in both cases, firms with one owner exhibit a greater mean than firms with multiple owners). Single-owned firms also used less debt, but the result was not statistically significant.

Table 5 Results of Student's t-test

	Mean		t statistic
	Single-owned firms	Multiple-owned firms	
Return on equity (ROE)	16.330	15.877	1.092
Asset turnover (AT)	6.038	5.273	5.073***
Current ratio (CR)	5.554	5.055	5.374***
Gearing (GE)	46.672	47.953	-1.136

Note: *** - significant at the 0.01 level, two-tailed significance

Source: Own analysis based on Bureau van Dijk's Amadeus database

To summarize the results, we found convincing evidence that the number of owners negatively affects asset turnover (H2). Not enough evidence on the effects of number of owners on profitability (H1), debt use (H3) and liquidity (H4) has been found.

The results support the hypothesis that agency costs increase along with the number of owners. This can be explained by the occurrence of the free-rider problem (Ang et al., 2000), which means that when the number of shareholder increases, the individual shareholders become less active and are unwilling to carry the costs of management monitoring. As a result, the asset turnover will decrease. This finding, however, does not apply to return on equity. Although the mean ROE of single-owned firms was higher, the difference is not statistically significant. It may also be that ROE is actually not a good inverse measure of agency costs; several authors considered them to be different constructs (see e.g. Lins et al., 2010).

Our results failed to support the hypotheses H3 and H4. The number of owners does not directly affect liquidity of firms and their use of debt. A higher use of debt can be attributed rather to the firm size (larger firms have better access to external finance) rather than to the number of shareholders.

However, it seems that single-owned firms are empirically different from firms with multiple owners as such, but the very number of owners does not play a significant role. A greater risk aversion of firms with a one owner is manifested in greater liquidity of such firms. Keeping more liquid assets acts as a "financial pillow" and reduces the risk of financial distress.

However, this study also has limitations. In the Czech Republic, only few privately-held firms have a large number of owners. The groups of firms corresponding to individual numbers of shareholders are disproportional in terms of size. For example, only one firm had 24 shareholders, and no firm had 29 shareholders. These data issues reduce the possibilities of statistical inference, since the information about the group means is distorted. A larger number of observations for various groups of firms could provide more reliable results. We also had to rely on the credibility of data extracted from the BvD Amadeus Database. However, this database has been used by many other authors in their research.

4 Conclusions

The goal of this paper was to explore the effects of the existence of multiple owners of financial performance of Czech privately-held firms. The results support the hypothesis that the number of shareholders negatively affects asset management efficiency. However, no significant effect of the number of owners on return on equity, liquidity and debt use has been found. Instead, we argue that single-owned firms are different from firms with multiple owners, as they tend to employ more liquid assets to reduce the financial risk.

However, further research is needed in this area. Some authors, such as Chrisman et al. (2004), emphasized the need for measuring not only economic (financial), but also noneconomic performance (the achievement of noneconomic goals, such as the firm reputation, contribution to society, but also family-centered goals in family firms). Moreover, future research should address the question how exactly the owning group dynamics (such as shared vision, commitment to the organization, quality of relationships) affects the performance of firms and what are the antecedents and the driving mechanisms of these effects.

Acknowledgments

This paper has been written with the support of the Czech Science Foundation, project no. GA17-10948S „Privately-held Firms with Multiple Owners: The Role of Family and Responsible Ownership“.

References

- Ang, J. S., Cole, R. A., Lin, J. W. (2000). Agency costs and ownership structure. *The Journal of Finance*, vol. 55(1), pp. 81-106.
- Chrisman, J. J., Chua, J. H., Litz, R. A. (2004). Comparing the agency costs of family and non-family firms: Conceptual issues and exploratory evidence. *Entrepreneurship Theory and practice*, vol. 28(4), pp. 335-354.
- Dalbor, M. C., Kim, A., Upneja, A. (2004). An initial investigation of firm size and debt use by small restaurant firms. *The Journal of Hospitality Financial Management*, vol. 12(1), pp. 41-48.
- Demsetz, H. (1983). The structure of ownership and the theory of the firm. *The Journal of Law and Economics*, vol. 26(2), pp. 375-390.
- Fleming, G., Heaney, R., McCosker, R. (2005). Agency costs and ownership structure in Australia. *Pacific-Basin Finance Journal*, vol. 13(1), pp. 29-52.
- Florackis, C. (2008). Agency costs and corporate governance mechanisms: Evidence for UK firms. *International Journal of Managerial Finance*, vol. 4(1), pp. 37-59.
- Jensen, M. C., Meckling, W. H. (1992). Specific and general knowledge, and organizational structure. In: Werin, L., Wijkander, H., ed., *Contract economics*. Oxford: Basil Blackwell, pp. 251-274.
- Konečný, L., Částek, O. (2016). The Effect of Ownership Structure on Corporate Financial Performance in the Czech Republic. *Ekonomický časopis*, vol. 64(5), pp. 477-498.

- Lappalainen, J., Niskanen, M. (2012). Financial performance of SMEs: impact of ownership structure and board composition. *Management Research Review*, vol. 35(11), pp. 1088-1108.
- Lins, K. V., Servaes, H., Tufano, P. (2010). What drives corporate liquidity? An international survey of cash holdings and lines of credit. *Journal of Financial Economics*, vol. 98(1), pp. 160-176.
- Machek, O., Kubíček, A. (2018). The relationship between ownership concentration and performance in Czech Republic. *Journal of International Studies*, vol. 11(1), pp. 177-186.
- Madsen, E. S., Smith, V., Dilling-Hansen, M. (2007). Why does any firm have several owners? *Corporate Ownership & Control*, vol. 4(3), pp. 80-86.
- McCahery, J. A., Vermeulen, E. P. (2010). *Corporate governance of non-listed companies*. Oxford: Oxford University Press.
- Mishra, C. S., McConaughy, D. L. (1999). Founding family control and capital structure: The risk of loss of control and the aversion to debt. *Entrepreneurship Theory and Practice*, vol. 23, pp. 53-64.
- Misra, S., Coughlan, A. T., Narasimhan, C. (2005). Salesforce compensation: An analytical and empirical examination of the agency theoretic approach. *Quantitative Marketing and Economics*, vol. 3(1), 5-39.
- Mustakallio, M., Autio, E., Zahra, S. A. (2002). Relational and contractual governance in family firms: Effects on strategic decision making. *Family business review*, vol. 15(3), pp. 205-222.
- Newman, A., Borgia, D., Deng, Z. (2013). How do SMEs with single and multiple owners finance their operations differently? Empirical evidence from China. *Thunderbird International Business Review*, vol. 55(5), pp. 531-544.
- Nordqvist, M., Melin, L. (2001). Exploring the dynamics of family firms: linking corporate governance to strategy change. In: *17th EGOS Colloquium*. Lyon, pp. 5-7.
- Singh, M., Davidson, W. N. (2003). Agency costs, ownership structure and corporate governance mechanisms. *Journal of Banking & Finance*, vol. 27(5), pp. 793-816.
- Steijvers, T., Voordeckers, W., Vandemaele, S. (2006). Ownership, governance and financial performance in small and medium-sized family firms. In: *RENT XX Conference*. Brussels.
- Uhlaner, L. M., Floren, R. H., Geerlings, J. R. (2007). Owner Commitment and Relational Governance in the Privately-Held Firm: An Empirical Study. *Small Business Economics*, vol. 29(3), pp. 275-293.
- Uhlaner, L. M. (2008). *The role of ownership in governance: A neglected focus in entrepreneurship and management research*. Breukelen: Nyenrode business universiteit.
- Uhlaner L. M., Berent-Braun M. M., Flören R. (2015). The influence of ownership social capital on the performance of privately-held firms: A lagged effect. In: *Family Enterprise Research Conference (FERC)*. Burlington: University of Vermont, June 4-7.
- Young, M. N., Peng, M. W., Ahlstrom, D., Bruton, G. D., Jiang, Y. (2008). Corporate governance in emerging economies: A review of the principal-principal perspective. *Journal of Management Studies*, vol. 45(1), pp. 196-220.

Spatial Inequality in Ownership and Activity of Banking Sector: Case of Russia

Marina Malkina

Lobachevsky State University of Nizhni Novgorod
Institute of Economics and Entrepreneurship
Macroeconomics and Microeconomics Center
Bolshaya Pokrovskaya street 37
603000 Nizhni Novgorod, Russia
E-mail: mmuri@yandex.ru

Abstract: *Our study is aimed at evaluation of spatial inequality in ownership and activity of commercial banks of Russian Federation in 2001-2016. The level of interregional inequality in banking sector was assessed for its assets, financial results, attracted deposits and provided loans, which were calculated both per capita and as their ratio to GRP of regional economies. To eliminate the effect of price level on the variables in time series we determined their real values using the cumulative GRP-deflator indices. The inequality in spatial distribution of assets, liabilities and financial results of banking sector was evaluated by means of the weighted coefficients of Gini and variation and tested for β - and σ -types convergence. We found significant growth of the spatial concentration of ownership and management of assets in Russian banking sector accompanied by low and cyclical concentration of financial results (net profits) within the sector, which meantime increased noticeably last year. At the same time, banking activity demonstrated much lower and sometimes diminishing regional disparities. First of all, we observed decrease in spatial inequality in the level of lending to enterprises and population, and the both types of convergence were proved for them. This trend was opposite to the growth of interregional disparities in the average personal deposits and almost nil change in inequality of the deposits of enterprises. We concluded that discrepancy between distribution of ownership on assets and actual implementation of banking activity, in combination with high interest rate (cost of capital), contributed to further redistribution of financial resources of the periphery in favor of the center and prevented the improvement of financial position of backward regions.*

Keywords: *region, banking system, unevenness, assets, convergence*

JEL codes: *G21, R12*

1 Introduction

The spatial inequality in the distribution of property and activities in the banking sector is a fairly new area of economic research. Previous studies in the field of spatial economics and new economic geography focused mainly on interregional inequality in GDP, employment, incomes of the population etc.

Studies of the banking sector's spatial location have been less common and usually concerned the analysis of expansion of global banks and crowding out of domestic banks in regions (Lee and Eun-Joo, 2017), or the processes of convergence of various countries' financial markets (Nițoi and Poche, 2016). Some researchers also investigated influence of financial deepening and banks development on regional economic growth (Hasan et al., 2009; Belke et al., 2016; Asteriou and Spanos, 2018) and income inequality (Haan and Sturm, 2017; D'Onofrio et al., 2017). Other scientists examined relationships between convergence in the banking sector and indicators of economic development. Thus, testing of the Turkish regions for conditional β -convergence (Birkan and Akdogu, 2016) did not provide evidence that alignment of regional financial imbalances led to an evening-out of regional gross value added per capita.

A number of studies were dedicated to analysis of the spatial distribution of the Russian banking sector's activity, its causes and consequences. For example, (Malkina, 2017) used various indices for assessment of spatial inequality in the banking sector of Russia, which

allowed to determine the level and dynamics of interregional disproportions in provision of Russian regions with banking services. Other authors (Ageeva and Mishura, 2017) analyzed the determinants of the level of development of regional banking systems in Russia and obtained evidence that it was affected by both economic and institutional factors, such as the republican status, distinctive national and ethnic characteristics and degree of regional authorities' independence. The researchers also distinguished regional, multi-regional and federal banks with extended branch network in Russia and explored their competitive advantages and weaknesses (Rykova et al., 2017). In the work by (Valiullin and Merzlyakova, 2011) the authors concluded that the territorial expansion of Moscow and other large banks contributed to the development of competition in the Russian banking sector.

The aim of our current study is to evaluate the degree of interregional unevenness in the distribution of assets, profits, loans and deposits of population and enterprises in the banking sector of Russia in dynamics, to test all these parameters for sigma- and beta-convergence and to compare inequality in distribution of the property and management and the actual implementation of banking activities in Russian regions. We expect that this study should shed light on the dynamics and conservation of regional imbalances in the Russian banking sector.

2 Methodology and Data

Our study is based on the official data provided by the Central Bank of Russia embracing the indicators of activity of all credit institutions (banks and their branches) in 80 Russian regions in 2001-2016. The analysis also involved the data of the Federal State Statistics Service of Russian Federation on the average population, gross regional product (GRP), GRP's volume and deflator indices for Russian regions in the period reviewed.

We studied two types of spatial distribution of banking activity. The first type of spatial distribution, related to property and general management in the banking system, was assessed on the basis of the data on banks registered in the regions, including value of their assets, net financial results (profits less losses), deposits and loans. The second type of spatial distribution, concerned the actual implementation of banking activities, including attracted deposits and issued loans, was evaluated on the basis of information on all credit institutions operating in the given territories: the headquarters and branches of banks registered in the regions and the branches of other banks headquartered in other regions. This type of distribution covers activities of both regional banks and cross-regional banks.

Since the economies of Russian regions differ significantly in scale, the level of banking activity in Russian regions was determined on the basis of relative indicators, such as: the ratio of annual personal deposits or loans to the average population of the regions; the ratio of assets, financial results, annual deposits or loans provided to enterprises to GRP of the regions. To eliminate the influence of the inflation factor, the procedure for deflating the nominal variables was carried out using the cumulative GRP deflator indices. Stock variables, determined on a certain date, were transformed into flow variables by calculation of their chronological mean values in the correspondent years.

The interregional inequality of bank assets and profits, deposits and loans was measured using two indices:

- the Gini coefficient (based on M. Brown formula):

$$G = 1 - \sum_{i=1}^n \rho_i (X_{i-1} + X_i), \quad (1)$$

where ρ_i - the share of i-th region in total population of country (for indicators related to population), or the share of i-th region in the total real GRP or assets (for indicators related to legal entities); $X_i = \sum_{i=1}^n x_i$ - the cumulative share of regions from the 1st to the i-th in

total value of indicator (loans, deposits, assets or profits), provided that all the regions are ranked in ascending order of its per capita or relative value y_i ,

and $x_i = \rho_i y_i / \sum_{i=1}^n \rho_i y_i$;

- the coefficient of variation:

$$CV = \sqrt{\sum_{i=1}^n \rho_i (y_i - \mu)^2} / \mu, \quad (2)$$

where μ - the country average of y_i , and $\mu = \sum_{i=1}^n \rho_i y_i$. This coefficient was also used for testing banks activities in the regions for sigma-convergence.

For the purpose of testing the banks activities in the regions for beta-convergence, we used the procedure proposed by (Baumol, 1986) and then developed in (Barro and Sala-i-Martin, 1992). This approach involves the construction of a spatial dependence of the average annual growth rate of the examined indicator on its initial value:

$$\frac{1}{T} \ln(y_{iT} / y_{i0}) = \beta_1 + \beta_2 \cdot \ln(y_{i0}) + \varepsilon_i, \quad (3)$$

where y_{i0} - per capita or relative value of correspondent indicator in i-th region in the initial year of the study, $t=0$; y_{iT} - its value in the final year of the study, $t=T$; T - total number of years in time series; ε_i - residuals of the model.

The above equation can also be written in the following form:

$$(y_{iT} / y_{i0})^{1/T} = \beta_0 \cdot y_{i0}^{\beta_2} + u_i, \quad (4)$$

where $\beta_0 = \exp(\beta_1)$ and $u_i = \exp(\varepsilon_i)$.

The inverse relationship in this test confirms the existence of β -convergence, that is, the catching-up of the backward regions with advanced regions by the examined parameter.

3 Results and Discussion

First of all, we should outline some relevant trends in the banking sector of the Russian Federation in the studied period. One of these trends was a sharp reduction in the number of banks, which was caused by the recession in economy and the tightening of banking regulation in Russia. At the beginning of 2001, there were 1311 credit institutions registered in various regions of Russia, and 3973 branches of credit institutions, of which 1095 were located in the same regions as their headquarters. Thus, in 2001 the share of own credit institutions in the regions accounted for 47.1% of all operating institutions. In early 2017, the number of registered credit institutions in the regions decreased to 623, the number of their branches - to 1098, of which 124 were located in the regions of the headquarter organizations. Thus, over 16 years the share of own credit institutions in the regions decreased to 43.4%, i.e. by 3.7 percentage points.

Another important trend was the expansion of Moscow banks in the regions. However, the crisis phenomena and tightening of regulation affected these banks as well. Some of large federal banks, in order to optimize activities, closed a part of their regional branches. However, on average this did not reduce the share of the banking market serviced by Moscow banks. Table 1 demonstrates the processes of concentration of banks and their assets incorporated in Moscow in comparison with other economic indicators of the capital city.

Table 1 The Share of Moscow in Some Economic Indicators, %

	2001	2004	2007	2010	2013	2016
Total population	7.0	7.4	7.8	8.0	8.4	8.6
Total GRP	20.0	19.5	19.3	17.7	18.9	18.5
Number of registered banks*	n/a	50.3	49.9	49.3	51.7	52.2
Managing banking assets*	n/a	83.9	84.4	86.1	88.8	90.6

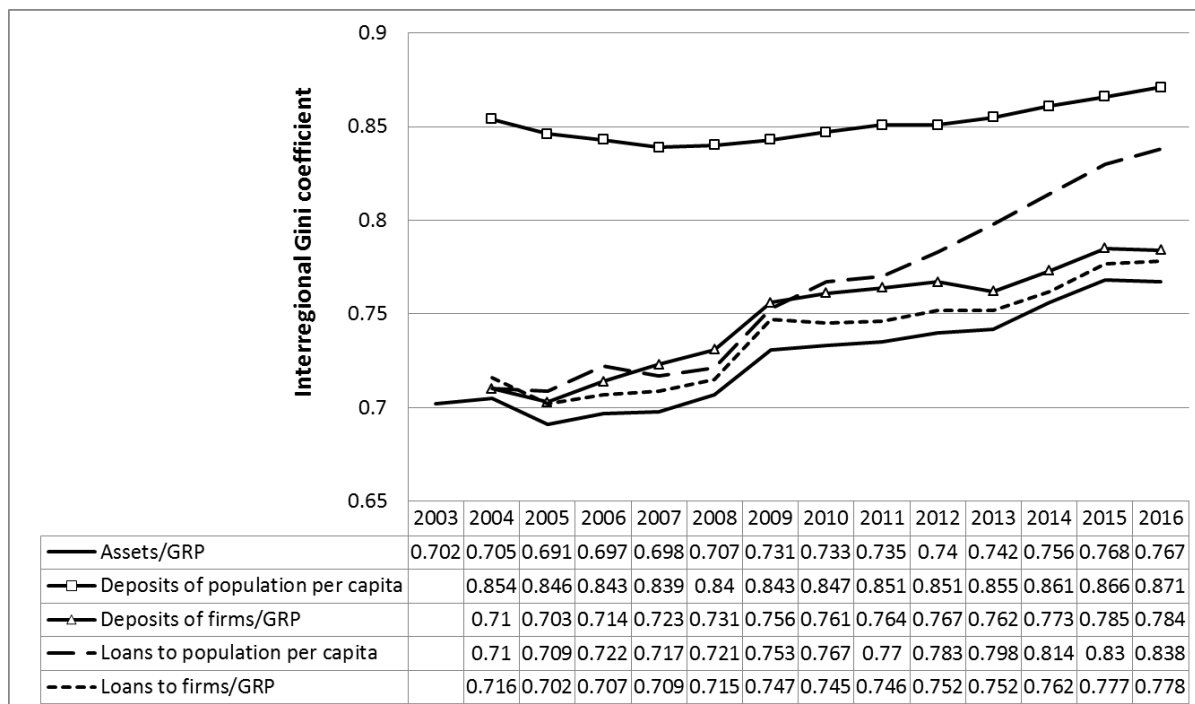
Note: *at the beginning of year

Source: author's own calculations based on the data officially provided by the Bank of Russia and the Federal State Statistics Service of Russian Federation

Now we can proceed to analysis of the levels of two types of spatial inequality in the Russian banking sector measured by means of the formulas 1-2.

Figure 1 with an embedded table represents the results of calculation of the Gini coefficient of interregional inequality for the indicators of banks registered in the regions. First of all, this figure demonstrates a high level of interregional differences in the distribution of property of bank assets. Moreover, for the deposits and loans of both population and enterprises, this inequality appeared to be even higher than for all assets on average. Among them, the maximum level of spatial inequality was observed for the personal deposits per capita, attracted by home regional banks, the minimum level - for the ratio of corporate loans to GRP provided by these banks.

The growth of inequality indices of all examined variables evidenced the concentration of property in the banking sector of Russia. Thus, the unevenness of assets distribution relative to GRP increased by 9.3% for 14 years, whereas the interregional inequality in the per capita loans provided by regional banks to population increased by 18.1% for 13 years. For banks registered in the regions, a minimum increase in inequality in 2003-2016, namely 2%, was observed for personal deposits per capita.

Figure 1 Interregional Inequality in Liabilities and Assets of Banks Registered in Regions

Source: author's own calculations based on the data provided by the Central Bank of Russia and the Federal State Statistics Service of Russian Federation (FSSS)

At the same time, very interesting data were obtained for spatial inequality of the ratio of net financial results to bank assets (the so called return on assets). The interregional Gini coefficient of this indicator was moderate until recently, although highly fluctuating, but it

soared up in 2016. Moreover, we identified two cycles of regional banks inequality in ROA within the period of 2003-2016. The first cycle, covering 2003-2010, reached a bottom point in 2006 (when $G=0.026$), which separated the downward and upward waves, and had a peak in 2010 (when $G=0.116$). The second cycle, lasting during 2010-2016, reached a minimum in 2012 ($G=0.038$) and showed a maximum in 2016 ($G=0.458$). However, more than 83% of the four-year growth occurred in the last year under study, when the crisis in Russian banking sector advanced.

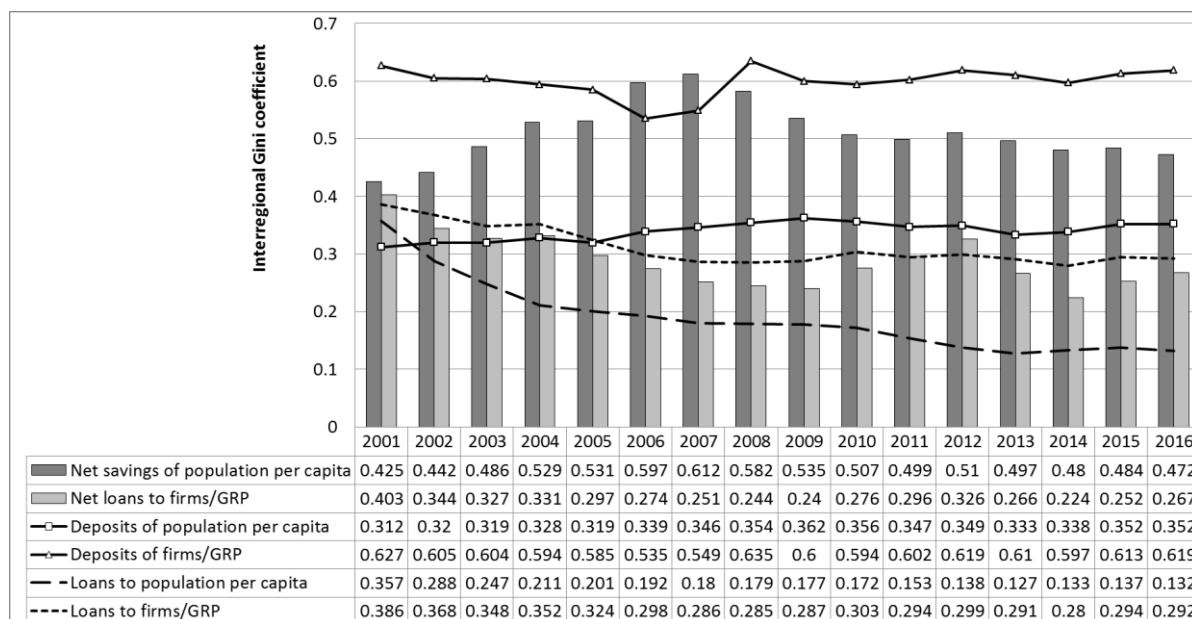
Figure 2 shows the results of calculation of the Gini coefficient for spatial inequality of actual banking activity in Russian regions. This activity embraces the performance of both regional banks and their home branches and subsidiaries of cross-regional banks registered in other regions, among which the dominant role belongs to Moscow banks. The comparison of figures 1 and 2 discovers a more even distribution of attracted deposits and provided loans in the regions than their distribution according to the place of banks incorporation. Moreover, in contrast to the observed increase in the concentration of banking assets ownership, the location of banking activity demonstrated a reduction in regional disparities.

This tendency was mainly related to the average loans to population, for which the interregional Gini coefficient declined by 63% during the period under review. To a lesser extent, it manifested itself for the level of loans to firms, which interregional Gini coefficient diminished by 24.3%. For these types of assets, the coefficient of variation decreased by 67.1% and 31.3% respectively, which proved the significant sigma-convergence of Russian regions in terms of lending.

For the loans to both population and enterprises, the hypothesis of the beta-convergence was also confirmed. The dependence between the level of loans to population in 2001 and the rate of its growth in 2001-2016 in Russian regions was described by a function with a negative slope:

$$\frac{1}{15} \ln(\hat{y}_{iT} / y_{i0}) = \underset{(0.0027)}{0.1869} - \underset{(0.0017)}{0.0494} \cdot \ln(y_{i0}) ; \left(\hat{y}_{iT} / y_{i0} \right)^{1/15} = 1.2055 \cdot y_{i0}^{-0.0494} ; R^2 = 0.912 .$$

Figure 2 Interregional Inequality in Actual Banking Activity



Source: Author's own calculations based on the data provided by the Central Bank of Russia and the Federal State Statistics Service of Russian Federation (FSSS)

This confirms approaching of backward regions to advanced regions on average in terms of the issued loans per capita. Indeed, the highest growth rates of the personal loans per

capita were observed exactly in the regions with their lowest initial levels, namely in the North Caucasian republics of Chechnya (where they increased 22067 times over 16 years) and Ingushetia (224.5 times), the southern border republics of Kalmykia (76 times) and Tyva (71 times), as well as in the Far Eastern republic of Sakha-Yakutia (75 times). On the contrary, the lowest growth rate of personal loans per capita (6.4 times) was found in Moscow, which used to be among the leaders by this indicator in 2001 and ranked second after the Magadan Region.

The relationship between the level of loans to enterprises in 2001 and its growth rate for 2001-2016 was slightly weaker, compared to that for loans to population, but also significant and negative by sign:

$$\frac{1}{15} \ln(\hat{y}_{iT} / y_{i0}) = -0.0708 - 0.0589 \cdot \ln(y_{i0}) ; \left(\hat{y}_{iT} / y_{i0} \right)^{1/15} = 0.9317 \cdot y_{i0}^{-0.0589} ; R^2 = 0.698.$$

(0.0126) (0.0044)

The largest increase in loans to enterprises was again indicated in the subjects of the North Caucasus Federal District - the Chechen (250 times) and the Karachay-Cherkess republics (16 times), and the subjects of the Volga Federal District - the republics of Mordovia (25 times) and Mari El (17 times). In 2001, these regions also demonstrated one of the lowest levels of lending to enterprises. However, the growth rates of corporate loans in backward regions turned out to be scattered, that can be attributed to the specifics of their economic structure, spatial location and institutional environment. It should also be noted that in 7 out of 80 regions the level of corporate loans even declined, and in all of them, with the exception of the Komi Republic, the initial level of lending was relatively higher than the national average.

For the deposits of both population and firms attracted in the regions, the level and dynamics of spatial inequality turned out to be fundamentally different. First of all, the interregional inequality of bank deposits noticeably exceeded interregional inequality of bank loans across the time. However, similar to loans, the spatial inequality of corporate deposits significantly surpassed the spatial inequality of personal deposits. Furthermore, unlike loans, which demonstrated regional convergence, regional disparities in the population's per capita deposits increased on average (according to the Gini coefficient, by 12.8%), and regional differences in the level of corporate deposits almost did not change. Meanwhile, according to the coefficient of variation, interregional inequality for both types of deposits increased (by 22.1% for personal deposits and by 11.7% for corporate deposits). This testifies existence of the sigma-divergence of Russian regions in terms of deposits.

Despite the evidence of a general divergence of Russian regions in terms of attracted deposits, the correspondent test confirmed the existence of beta-convergence for personal deposits. Indeed, the relationship between their level of 2001 and its average growth rate in 2001-2016 can be expressed by the functions:

$$\frac{1}{15} \ln(\hat{y}_{iT} / y_{i0}) = 0.1688 - 0.0424 \cdot \ln(y_{i0}) ; \left(\hat{y}_{iT} / y_{i0} \right)^{1/15} = 1.1838 \cdot y_{i0}^{-0.0424} ; R^2 = 0.8759.$$

(0.0028) (0.0018)

The largest increase in deposits was again observed in the regions with their lower initial levels: in the republics of Chechnya, Ingushetia, Kabardino-Balkaria (all are the subjects of the North Caucasus Federal District) and in the Altai Republic (located in the Siberian Federal District). The smallest growth of personal deposits per capita (1.9 times) was observed in the Magadan Region, which was ranked first by this indicator in 2001. For corporate deposits, the beta-convergence was not confirmed.

The revealed mismatch between sigma- and beta- convergence for deposits of population is consistent with findings by other researchers who discovered a similar phenomenon in other spheres (Young, Higgins, Levy, 2008; Dvoroková, 2015).

Figure 2 also shows the change in regional unevenness of net per capita deposits of population (deposits minus loans) and net relative loans of enterprises (loans minus

deposits ratio to GRP). For net deposits of population the inequality initially increased, peaked in 2007, and then declined. Eventually, it increased by 11.1% according to the Gini coefficient and by 17.5% according to the coefficient of variation. For net loans to enterprises the inequality changed cyclically and ultimately decreased by 33.7% according to the Gini and by 38.5% according to the CV. In addition, the tests evidenced the absence of beta-convergence for both net personal deposits and net corporate loans.

Thus, we found a discrepancy between growing disparities in the regional distribution of ownership of bank assets and reducing disparities in provision of Russian regions with banking services, primarily lending. At the same time, the average gap between regions in the level of corporate deposits did not decrease. Besides, the gap of regions in the average personal deposits even widened, albeit these deposits were redistributed in space in favor of poor regions.

How can we explain the discrepancy? In our view, one of the reasons of this phenomenon is the high real interest rate, which largely contributes to the preservation of financial backwardness of regions - net debtors and supports further improvement of the position of regions - net creditors. Moreover, the redistribution of property rights of financial resources in favor of federal banks leads to redistribution of banks' incomes and risks in this direction as well.

4 Conclusions

Our study is dedicated to comparative analysis of interregional inequality in ownership and management of banking assets, on the one hand, and implementation of actual banking activities, on the other hand. For this purpose we evaluated inequality in spatial distribution of banking assets, profits, deposits and loans to population and enterprises relatively to distribution of population, GRP and banking assets in regions. The interregional inequality was assessed for both credit organizations incorporated on a certain territory and credit organizations operated there. The level of spatial inequality was evaluated in dynamics by means of the weighted Gini coefficient and the coefficient of variation and tested for sigma- and beta-convergence using the technique developed by Baumol and Barro & Sala-i-Martin.

As a result, we found a significant increase in the spatial concentration of ownership and asset management in the Russian banking sector and the growing expansion of Moscow banks to other regions. Meanwhile, these processes were accompanied by the alignment of actual banking activities in the regions. The difference between the level of borrowing of enterprises and the population from the banking system has significantly reduced, and for corporate and personal loans both types of regional convergence were confirmed. On the contrary, the deposits of population per capita demonstrated an increase in interregional imbalances. However, the sigma-divergence of regions by personal deposits was accompanied by their beta convergence by this type of liabilities. Further, the deposits of enterprises showed only sigma-divergence, according to the coefficient of variation. Ultimately, we came to the conclusion that the opposite tendencies in the distribution of property and actual activity in the banking sector, combined with a high real interest rate, could lead to a further redistribution of the financial resources of the periphery in favor of the federal center and prevent the equalization of financial conditions of Russian regions.

References

- Ageeva, S., Mishura, A. (2017). Institutional Factors to Assess the Spatial Development of Regional Banks. *Region: Economics and Sociology*, vol. 2 (94), pp. 52-75, in Russian.
- Asteriou, D., Spanos, K. (2018). The Relationship between Financial Development and Economic Growth during the recent Crisis: Evidence from the EU. *Finance Research Letters*, in press.
- Barro, R.J., Sala-i-Martin, X. X. (1992). Convergence. *Journal of Political Economy*, vol. 100, pp. 223-51.

- Baumol, W.J. (1986). Productivity Growth, Convergence, and Welfare: What the Long-run Data Show. *American Economic Review*, vol. 76(5), pp. 1072-1085.
- Belke, A., Haskamp, U., Setzer, R. (2016). Regional bank efficiency and its effect on regional growth in "normal" and "bad" times. *Economic Modelling*, vol. 58, pp. 413-426.
- Birkan, A. O., Akdogu, S. K. (2016). The geography of financial intermediation in Turkey: 1988–2013. *The Annals of Regional Science*, vol. 57(1), pp. 31–61.
- Dvoroková, K. (2015). Sigma Versus Beta-convergence in EU 28: do they lead to different results? In: *Proceedings of The 5th MAC 2015*. Prague, pp. 88-94. Retrieved from: <http://www.wseas.us/e-library/conferences/2014/Tenerife/ECONMATH/ECONMATH-13.pdf/>.
- D’Onofrio, A., Minetti, R., Murro, P. (2017). Banking development, socioeconomic structure and income inequality. *Journal of Economic Behavior & Organization*, in press.
- Haan, J., Sturm, J.-E. (2017). Finance and income inequality: A review and new evidence. *European Journal of Political Economy*, vol. 50, pp. 171-195.
- Hasan, I., Wachtel, P., Zhoud, M. (2009). Institutional development, financial deepening and economic growth: Evidence from China. *Journal of Banking & Finance*, vol. 33(1), pp. 157-170.
- Lee, E.-J. (2017). Intra- and inter-regional portfolio diversification strategies under regional market integration: Evidence from U.S. global banks. *International Review of Financial Analysis*, vol. 54, pp. 1-22.
- Malkina, M.Yu. (2017). Uneven provision of Russian regions with banking services. *Finance and Credit*, vol. 23, issue 36(756), pp. 2136-2158, in Russian.
- Nițoi, M., Poche, M. M. (2016). Testing financial markets convergence in Central and Eastern Europe: A non-linear single factor model. *Economic Systems*, vol. 40(2), pp. 323-334.
- Rykova, I. N., Gubanov, R. S., Dansonova, B.S. (2017). Regional banking market in Russia: theory and practice. *Bankovskoe delo [Banking]*, vol. 8, pp. 24-33, in Russian.
- Valiullin, K. K., Merzlyakova, S. I. (2011). Tendencies towards the spatial concentration of the Russian banking sector. *Studies on Russian economic development*, vol. 22(5), pp. 526-534.
- Young, A.T., Higgins, M.J., Levy, D. (2008). Sigma Convergence versus Beta Convergence: Evidence from U.S. County-Level Data. *Journal of Money, Credit and Banking*, vol. 40, pp. 1083-1093.

The Use of Backtesting in Assessment of the Value-at-Risk on Unites States, Great Britain and German Capital Markets

Tomáš Meluzín¹, Marcin Faldziński², Michał Bernard Pietrzak³, Adam P. Balcerzak⁴, Marek Zinecker⁵

¹ Brno University of Technology
Faculty of Business and Management
Kolejní 2906/4, 61200 Brno, Czech Republic
E-mail: meluzint@fbm.vutbr.cz.

² Nicolaus Copernicus University in Toruń
Faculty of Economic Sciences and Management
Ul. Gagarina 13a, 87-100 Toruń, Poland
E-mail: marf@umk.pl

³ Nicolaus Copernicus University in Toruń
Faculty of Economic Sciences and Management
Ul. Gagarina 13a, 87-100 Toruń, Poland
E-mail: michal.pietrzak@umk.pl

⁴ Nicolaus Copernicus University in Toruń
Faculty of Economic Sciences and Management
Ul. Gagarina 13a, 87-100 Toruń, Poland
E-mail: adam.balcerzak@umk.pl

⁵ Brno University of Technology
Faculty of Business and Management
Kolejní 2906/4, 61200 Brno, Czech Republic
E-mail: zinecker@fbm.vutbr.cz

Abstract: *For many years, a progressive globalization process has been observed, which translates into an increase in interdependencies between world economies. This growing level of interdependence affects the functioning of economies significantly. The greatest impact of mutual connections can be observed on the world capital markets. Therefore, the issue of the identification and measurement of market risk becomes an important problem related to the functioning of capital markets. Value at Risk is a metric that allows the risk of loss for selected assets to be assessed. The research objective of this article is to assess the quality of Value at Risk applied to measure the risk of the DJIA, DAX, and FTSE stock indices. The VaR estimation was carried out in the time period 2000-2012, where the DCC-GARCH model with the conditional Student's t-distribution was used. To evaluate VaR quality, the backtesting procedure was used, within which we used the Juc, Jind, and Jcc tests.*

Keywords: *capital market, value-at-risk, backtesting, DCC-GARCH model, conditional variance*

JEL codes: *G15, C58*

1 Introduction

A progressive globalization process has been observed since the 1990s. This translates into an increase in interdependence between world economies and their respective markets. This phenomenon is becoming a significant factor affecting the efficiency of financial and banking systems in providing capital for growth of real sphere (Meluzin et al., 2017; 2018a; 2018b; Kubiszewska, 2017; Balcerzak et al., 2017; Gavurova et al., 2017; Dusatkova et al., 2017, Dvorsky et al., 2017; Ivanová, 2017). Therefore, it translates into countries' competitiveness and socio-economic situation (Cheba and Szopik-Depczyńska, 2017; Zygmunt, 2017).

The potential instability of international financial markets, which can be the result of these interdependencies, can have especially strong and negative influence for lower developed economies, which can suffer from rapid capital flows even in the case of effective national governance, or prudent fiscal and monetary policy (Sanusi et al., 2017; Mihóková et al., 2017; Simionescu et al., 2017; 2018)

The most dynamic growth as well as the variability of mutual dependencies can be observed in the case of financial markets, which is confirmed by the empirical research (Heryan and Ziegelbauer, 2016; Cevik et al., 2017; Faldziński et al., 2017; Pietrzak et al., 2017a; Vukovic et al., 2017). The identification and measurement of market risk resulting from the links between markets is an important indication for domestic decision-makers representing various financial institutions (Khan et al., 2016; Navid and Shabantaheri, 2017; Ahmed et al., 2018). Therefore, the issue of market risk management becomes a significant problem related to the functioning of capital markets. The greatest risk of loss relates to those assets that are listed on capital markets, where their capitalization is systematically increasing (Meluzin and Zinecker, 2016).

Value at Risk is a metric that allows the risk of loss for selected assets to be assessed. The major research objective of the proposed article is to assess the quality of Value at Risk applied to measure the risk of the DJIA, FTSE, and DAX stock indices. The VaR estimation was carried out in the time period 2000-2012, where the DCC-GARCH model with the conditional Student's t-distribution was used. To evaluate VaR quality, the backtesting procedure was used, within which we used the Juc, Jind, and Jcc tests.

2 Methodology and Data

The Value at Risk (VaR) metric is commonly used to assess risk for financial institutions (Smolović et al, 2017). The risk assessment concerns the financial assets held and, in accordance with the determined VaR, the institution must make appropriate reserves to secure potential losses. This means that Value at Risk belongs to the group of risk measures. VaR estimation is performed based on the knowledge of the distribution of returns of selected financial asset and allows determining the probability of loss occurrence. Determining the distribution parameters is a challenging task due to the volatility of the variance heteroscedasticity and due to the occurrence of interdependencies between markets and assets. Suitable modelling of returns distribution can be performed using the DCC-GARCH model (see Szumilo et al., 2018; Zinecker et al., 2016; 2017), which is defined by means of the following formulas:

$$\mathbf{Y}_t = \boldsymbol{\mu}_t + \boldsymbol{\eta}_t, \boldsymbol{\eta}_t | F_{t-1} \sim t(0, \mathbf{H}_t), \mathbf{H}_t = \mathbf{D}_t \mathbf{R}_t \mathbf{D}_t \quad (1)$$

$$\mathbf{D}_t^2 = \text{diag}\{\mathbf{H}_t\}, \quad (2)$$

$$H_{i,t} = \omega_i + \alpha_i \eta_{i,t-1}^2 + \beta_i H_{i,t-1} \quad (3)$$

$$\boldsymbol{\varepsilon}_t = \mathbf{D}_t^{-1} \boldsymbol{\eta}_t \quad (4)$$

$$\mathbf{R}_t = \text{diag}\{\mathbf{Q}_t\}^{-1/2} \mathbf{Q}_t \text{diag}\{\mathbf{Q}_t\}^{-1/2} \quad (5)$$

$$\mathbf{Q}_t = \boldsymbol{\Omega} + a \boldsymbol{\varepsilon}_{t-1} \boldsymbol{\varepsilon}_{t-1}' + b \mathbf{Q}_{t-1}, \boldsymbol{\Omega} = \bar{\mathbf{R}}(1 - a - b), \quad (6)$$

\mathbf{Y}_t - multivariate process of returns, t - conditional t-distribution with $\nu > 2$ degrees of freedom, $\boldsymbol{\mu}_t$ - the vector of conditional means of returns, \mathbf{H}_t - the conditional covariance matrix, $\mu_{i,t}$ - i -th equation of the conditional mean, $h_{i,t}$ - the conditional variance equation for i -th returns, where $i = 1, \dots, N$, $\omega_i, \alpha_i, \beta_i$ the parameters of the conditional variance equation, \mathbf{R}_t - conditional correlation matrix, \mathbf{Q}_t - quasi correlation matrix, $\bar{\mathbf{R}}$ - the unconditional covariance matrix of the standardize errors which can be estimated or set as $\bar{\mathbf{R}} = \frac{1}{T} \sum_{t=1}^T \boldsymbol{\varepsilon}_t \boldsymbol{\varepsilon}_t'$, a, b the parameters of the conditional correlation equation.

Aielli (2009) shows that the estimation of $\bar{\mathbf{R}}$ as the the empirical covariance matrix is inconsistent. So, we decided to estimate the unconditional covariance matrix.

Value-at-Risk (VaR) is a commonly used risk measurement technique. It can be applied to assess the probability of an asset loss, where different levels of probability and of the potential loss are assumed. Value at Risk can be defined as the amount of loss of an asset (portfolio) whose probability of reaching or exceeding it in a given time interval is equal to a given tolerance level. If the quantile of the distribution of the value of the asset (portfolio) r_α is determined using the formula below:

$$P(C \leq C_\alpha) = \alpha \quad (7)$$

then Value at Risk can be defined as follows:

$$VaR = -r_\alpha C_0, \quad (8)$$

where r is the return, C_0 is the initial value of the asset (portfolio), and α is the tolerance level (see: Dowd, 2005).

Within the first step of the procedure of VaR estimation we need to assume the distribution of the asset returns. The decided to estimate the DCC-GARCH model, and then use the parameter estimates to compute VaR. The use of the DCC-GARCH model allows taking into account the autocorrelation of returns and the properties of the variance heterogeneity in the form of autocorrelation of returns squares, as well as conditional correlations. Based on the results of the parameter estimation of the DCC-GARCH class models, VaR is estimated by applying the following formula:

$$VaR_q^t = -\mu_{t+1} + h_{t+1} z_q \quad (9)$$

where μ_{t+1} is a one period ahead forecast of conditional mean, h_{t+1} is a one period ahead forecast of conditional variance and z_q is the q -quantile of conditional distribution.

The second step of the VaR determination procedure, requires evaluating the quality of its estimates. After Value at Risk estimation its quality should be assessed. The VaR measure is tested for two properties: unconditional coverage and independence property. The first one assumes that the expected number of hits (cases when returns are greater than estimated VaR) given the assumed coverage level. The second one states that the hit process is independent. For this purpose the VaR estimates are compared to the realizations of the asset returns. In the article, in order to perform backtesting, we used the unconditional coverage test Juc, the test of independence Jind, and the conditional coverage test Jcc (Candelon et al., 2011). Candelon et al. (2011) show that the statistical power of these tests are greater than standard test used for backtesting.

3 Results and Discussion

Following the determined research objective of this article regarding the assessment of the quality of Value at Risk, the study will be conducted based on three stock indices, *i.e.*, DJIA, FTSE and DAX. The selection of indices will allow us to solve the problem of assessing the risk measurement related to the functioning of the US, UK and German capital markets. The study was conducted in the time period 2000-2012. Logarithmic returns were used to estimate the DCC-GARCH model and VaR. Returns were calculated based on the levels of selected indices and data was obtained from the Yahoo Finance website.

In accordance with the presented procedure for VaR estimation, in the first step the distribution of returns of selected stock indices should be determined. For this purpose, the parameter of the DCC-GARCH model with conditional t -distribution was estimated. The initial analysis of individual DJIA, FTSE and DAX indices indicated the correctness of the GARCH(1,1) model estimation for each of them. This information was used to determine the model specification, where the DCC-GARCH(1,1) model was adopted. Therefore, estimation of the model parameters was carried out and the results obtained are presented in Table 1. The analysis of the parameters estimates of the model indicates a good fit to the empirical data, which means that this model should describe the distribution of returns correctly. All parameters related to the conditional variance and conditional correlation equations were found to be statistically significant at the 5% significance level. For each of the equations of the conditional variance, the sum of $\alpha_i + \beta_i$ is less than 1. The estimates

of the parameter ν of the t -distribution confirms the occurrence of thick tails in the distribution of the returns.

Table 1 The Results of the Estimation of the Multivariate DCC-GARCH Model Parameters

The conditional variance equations			
Parameter	Estimate	Std. error	p-value
ω_1 (DJIA)	0.0168	0.0037	0.0000
α_1 (DJIA)	0.0605	0.0060	0.0000
β_1 (DJIA)	0.9312	0.0064	0.0000
ω_2 (DAX)	0.0114	0.0027	0.0000
α_2 (DAX)	0.0704	0.0080	0.0000
β_2 (DAX)	0.9204	0.0084	0.0000
ω_3 (FTSE)	0.0124	0.0027	0.0000
α_3 (FTSE)	0.0696	0.0073	0.0000
β_3 (FTSE)	0.9213	0.0076	0.0000
ν	8.9725	0.7264	0.0000
The conditional correlation equation			
Parameter	Estimate	Std. error	p-value
α	0.0198	0.0033	0.0000
β	0.9746	0.0054	0.0000
R_{12}	0.5242	0.0691	0.0000
R_{13}	0.8190	0.0304	0.0000
R_{23}	0.4784	0.0728	0.0000

Source: own calculations.

Therefore, it was decided to use DCC-GARCH model to estimate Value-at-Risk. The procedure consisted in estimating DCC-GARCH(1,1) model for last 2000 observations applying rolling window approach. The first model was estimated based on the initial 1000 observations, and each subsequent model was based on the data window, shifted one-day session forward. In this way 2000 one-day ahead VaR forecasts were obtained. Each forecast is a measure of the risk of incurring a particular loss at a given probability level. Thus, market risk forecasts were obtained for each of the three indices.

Then, in accordance with the assumed objective of the article, the quality of VaR obtained was evaluated on the basis of the backtesting procedure. The results of the binominal tests are presented in Table 2. The analysis of the results obtained based on the Juc, Jcc, and Jind tests indicates the correctness of VaR in terms of unconditional coverage and independence for all three indices. For most lags, there is no reason to reject the null hypothesis at the 5% significance level, which indicates that the VaR properties are appropriate for each of the tests. Only in two cases the null hypothesis is rejected, for DAX Jcc test and for DJIA Jind test.

Table 2 Results for Juc, Jcc, Jind Tests for 95% Confidence Level

Index	Test	Statistic	Simulated p-value	Test	Statistic	Simulated p-value
DJIA	Juc(p=1)	1.3534	0.2403	Jind(p=1)	0.0095	0.7993
	Jcc(p=2)	4.9370	0.0784	Jind(p=2)	4.7987	0.0216
	Jcc(p=3)	7.2218	0.0594	Jind(p=3)	6.5493	0.0280
	Jcc(p=4)	7.3700	0.0764	Jind(p=4)	6.5811	0.0424

	Jcc(p=5)	7.4074	0.0919	Jind(p=5)	6.7672	0.0519
	Jcc(p=6)	7.4083	0.1126	Jind(p=6)	6.8188	0.0672
FTSE	Juc(p=1)	3.8365	0.0447	Jind(p=1)	0.0088	0.8841
	Jcc(p=2)	4.8683	0.0817	Jind(p=2)	0.9527	0.2899
	Jcc(p=3)	6.4406	0.0748	Jind(p=3)	3.1778	0.1133
	Jcc(p=4)	8.1640	0.0631	Jind(p=4)	4.8119	0.0837
	Jcc(p=5)	9.5744	0.0547	Jind(p=5)	5.7938	0.0746
	Jcc(p=6)	10.5593	0.0552	Jind(p=6)	6.3225	0.0838
DAX	Juc(p=1)	4.8896	0.0276	Jind(p=1)	0.0086	0.8951
	Jcc(p=2)	6.5668	0.0433	Jind(p=2)	1.7289	0.1479
	Jcc(p=3)	8.3263	0.0415	Jind(p=3)	3.7312	0.0820
	Jcc(p=4)	9.4476	0.0420	Jind(p=4)	4.1612	0.1009
	Jcc(p=5)	9.8601	0.0492	Jind(p=5)	4.1717	0.1409
	Jcc(p=6)	9.9473	0.0596	Jind(p=6)	4.1787	0.1831

Bold values means rejection of the null hypothesis based on the 5% significance level.

Source: Source : own calculations.

4 Conclusions

The article addresses the issue of the identification and measurement of market risk of assets listed on capital markets. The increasing level of interdependence between economies affects the situation on capital markets significantly; therefore the problem of market risk becomes a major problem related to their functioning. A commonly used tool for assessing the risk of losses for selected assets is the Value at Risk measure. The research objective of the article was to estimate Value at Risk for selected DJIA, DAX and FTSE stock indices, as well as to assess the quality of the determined values of VaR. In order to verify the properties of VaR, the backtesting procedure was applied, in which the Juc test, Jind test and Jcc test were used. The results of the tests allowed us to determine good properties with regard to the tested capital markets of the United States, Great Britain, and Germany.

References

- Aielli, G. (2009). *Dynamic conditional correlations: on properties and estimation*. Department of Statistics, University of Florence, Mimeo.
- Ahmed, A., Ali, R., Ejaz, A., Ahmad, M. I. (2018). Sectoral integration and investment diversification opportunities: evidence from Colombo Stock Exchange. *Entrepreneurship and Sustainability Issues*, vol. 5(3), pp. 514-527.
- Balcerzak, A. P., Klietk, T., Streimikiene, D., Smrčka L. (2017). Non-parametric approach to measuring the efficiency of banking sectors in European Union Countries. *Acta Polytechnica Hungarica*, vol. 14(7), pp. 51-70.
- Candelon, B., Colletaz, G., Hurlin, C., Tokpavi, S. (2011). Backtesting Value-at-Risk: A GMM Duration-based Test. *Journal of Financial Econometrics*, vol. 9(2), pp. 314-343.
- Cevik, E. I., Korkmaz, T., Cevik, E. (2017). Testing causal relation among Central and Eastern European equity markets: evidence from asymmetric causality test. *Economic Research-Ekonomska Istraživanja*, vol. 30(1), pp. 381-393.
- Cheba, K., Szopik-Decpzyńska, K. (2017). Multidimensional comparative analysis of the competitive capacity of the European Union countries and geographical regions. *Oeconomia Copernicana*, vol. 8(4), pp. 487-504.
- Dowd, K. (2005). *Measuring Market Risk*. John Wiley & Sons Ltd.

- Dusatkova, M. S., Zinecker, M. Meluzin, T. (2017). Institutional Determinants of Private Equity Market in Czech Republic. *Economics & Sociology*, vol. 10(4), pp. 83-98.
- Dvorsky, J., Sopkova, G., Janoskova, M. (2017). Evaluation of Social Environment and Access to Financial Resources for Business: Case Study of the Czech and Slovak Republic. *Economicko-manazerskie spektrum/Economic and Managerial Spectrum*, vol. 11(1), pp. 62-73.
- Fałdziński, M., Balcerzak, A.P., Meluzín, T., Pietrzak, M. B., Zinecker, M. (2016). Cointegration of Interdependencies Among Capital Markets of Chosen Visegrad Countries and Germany. In: Kocourek, A., Vavrousek, M., eds., *34th International Conference Mathematical Methods in Economics MME 2016 Conference Proceedings*. Liberec: Technical University of Liberec, pp. 189-194.
- Gavurova , B., Belas, J., Kocisova, K., Dapkus, R., Bartkute, R. (2017). Revenue and Cost Efficiency of Banking Sectors in The European Union Countries: Do They Depend on Size, Location or Crisis Period? *Transformations in Business and Economics*, vol. 16 No. 2(41), pp. 124-127.
- Heryan, T., Ziegelbauer, J. (2016). Volatility of yields of government bonds among GIIPS countries during the sovereign debt crisis in the euro area. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, vol. 11(1), pp. 61-74.
- Ivanová, E. (2017). Barriers to the development of SMEs in the Slovak Republic. *Oeconomia Copernicana*, vol. 8(2), pp. 255-272.
- Khan, F., Rehman, S.-U., Khan, H., Xu, T. (2016). Pricing of risk and volatility dynamics on an emerging stock market: evidence from both aggregate and disaggregate data. *Economic Research-Ekonomska Istraživanja*, vol. 29(1), pp. 799-815.
- Kubiszewska, K. (2017). Banking concentration in the Baltic and Western Balkan states — selected issues. *Oeconomia Copernicana*, vol. 8(1), pp. 65-82.
- Meluzín, T., Balcerzak, A.P., Pietrzak, M. B., Zinecker, M., Doubravský, K. (2018a). The impact of rumours related to political and macroeconomic uncertainty on IPO success: evidence from a qualitative model. *Transformations in Business & Economics*, vol. 17, 2A(44).
- Meluzín, T., Pietrzak, M. B., Balcerzak, A. P., Zinecker, M., Doubravský, K., Dohnal, M. (2017). Rumours Related to Political Instability and their Impact on IPOs: The Use of Qualitative Modeling with Incomplete Knowledge. *Polish Journal of Management Studies*, vol. 16(2), pp. 171-187.
- Meluzin, T., & Zinecker, M. (2016). Trends in IPOS: the evidence from CEE capital markets. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, vol. 11(2), pp. 327-341.
- Meluzín, T., Zinecker, M., Balcerzak, A.P., Doubravský, K., Pietrzak, M. B., Dohnal, M. (2018b). The timing of initial public offerings – non-numerical model based on qualitative trends. *Journal of Business Economics and Management*, vol. 19(1), pp. 63-79.
- Mihóková, L., Martinková, S., & Dráb, R. (2017). Short-term fiscal imbalance comparison in V4 countries using a dynamic conditional correlation approach. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, vol. 12(2), pp. 261-280.
- Navid, B.J., Shabantaheri, P. (2017). The development of capital market and bank risk: The Case of Iran. *International Review*, vol. 1-2, pp. 99-107.
- Pietrzak, M. B., Fałdziński, M., Balcerzak, A. P., Meluzín, T., Zinecker, M. (2017a). Short-term Shocks and Long-term Relationships of Interdependencies Among Central European Capital Markets. *Economics & Sociology*, vol. 10(1), pp. 61-77.
- Pietrzak, M. B., Łaszkiwicz, E., Balcerzak, A. P., Meluzín, T., Zincker, M. (2017b). Identification of the Direction of Changes in the Structure of Interdependence among the US Capital Market and the Leading European Markets. In: Pražák, P., ed., *35th*

International Conference Mathematical Methods in Economics MME 2017 Conference Proceedings. Hradec Králové: University of Hradec Králové, pp. 572-577.

Sanusi, K. A., Meyer, D., Ślusarczyk, B. (2017). The relationship between changes in inflation and financial development. *Polish Journal of Management Studies*, vol. 16(2), pp. 253-265

Simionescu, M., Lazányi, K., Sopková, G., Dobeš, K., Balcerzak, A. P. (2017). Determinants of Economic Growth in V4 Countries and Romania. *Journal of Competitiveness*, vol. 9(1), pp. 103-113.

Simionescu, M., Balcerzak, A.P., Bilan, Y., Kotásková, A. (2018). The impact of money on output in Czech Republic and Romania. *Journal of Business Economics and Management*, vol. 19(1), pp. 20-41.

Smolović, J.C., Lipovina-Božović, M., Vujošević, S. (2017). GARCH models in value at risk estimation: empirical evidence from the Montenegrin stock exchange. *Economic Research-Ekonomska Istraživanja*, vol. 30(1), pp. 477-498.

Szumilo, N., Bienert, S., Łaszkiwicz, E., Pietrzak, M. B., Balcerzak, A. P. (2018). The real alternative? A comparison of German real estate returns with bonds and stocks. *Journal of Property Investment & Finance*, vol. 36(1), pp. 19-31.

Vukovic, D., Hanic, E., Hanic, H. (2017). Financial integration in the European Union - the impact of the crisis on the bond market. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, vol. 12(2), pp. 195-210.

Zinecker, M., Balcerzak, A. P., Fałdziński, M., Meluzín, T., Pietrzak, M. B. (2016). Application of DCC-GARCH Model for Analysis of Interrelations Among Capital Markets of Poland, Czech Republic and Germany. In: Reiff, M., Gezik, P., eds., *Proceedings of the International Scientific Conference Quantitative Methods in Economics Multiple Criteria Decision Making XVIII*. Vratna: Letra Interactive, pp. 416-421.

Zinecker, M.; Łaszkiwicz, E., Meluzin, T., Pietrzak, M. B., Balcerzak, A. P. (2017). Assessment of Changes in the Trend of Interdependences between the Capital Market of Germany and the Markets of Poland, the Czech Republic and Hungary. In: Nešleha, J., Plíhal, T., Urbanovský, K., eds., *Proceedings of the 14th International Scientific Conference European Financial Systems 2017*. Brno: Masaryk University, part 2, pp. 492-500.

Zygmunt, A. (2017). Innovation activities of Polish firms. Multivariate analysis of the moderate innovator countries. *Oeconomia Copernicana*, vol. 8(4), pp. 505-521.

Changes in Consumer Credit Market in Slovakia

Michal Mešťan¹, Maroš Malíček², Matej Žofaj³, Ivan Králik⁴

¹ Matej Bel University
Faculty of Economics, Department of Finance and Accounting
Tajovského 10, 975 90 Banská Bystrica, Slovakia
E-mail: michal.mestan@umb.sk

^{2,4} Matej Bel University
Faculty of Economics, Department of Public Economics and Regional Development
Tajovského 10, 975 90 Banská Bystrica, Slovakia
E-mail: maros.malicek@umb.sk², ivan.kralik@umb.sk⁴

³ Matej Bel University
Faculty of Economics, Department of Tourism and Hospitality
Tajovského 10, 975 90 Banská Bystrica, Slovakia
E-mail: matej.zofaj@umb.sk⁴

Abstract: *Slovak households have been among the fastest-growing debtors of all EU countries in the past 10 years. Consumer credit regulation in Slovakia over the last 3 years has considerably tightened the terms of consumer credit provision not only for banks but especially for non-bank entities that have had to undergo relicensing. In this article, we focus on the analysis of consumer behavior and the structure of consumer credit granted to households by banks and non-bank entities, taking into account the volumes of new loans and their prices, expressed in interest rates and annual percentage rate of charge. At the same time, we evaluate the real effect of the tightened regulation on the consumer credit market for households in Slovakia.*

Keywords: *banks, non-banks, annual percentage rate of charge, interest rates, consumer credit.*

JEL codes: *E51, P36, G21, G23, H31*

1 Introduction

The consumer credit market is an integral part of the market economy. It allows economic entities with a shortage of capital to obtain the necessary resources to finance and satisfy their needs from economic subjects with surplus capital. The basic entity operating in the consumer credit market are banks. In addition to banks, non-bank entities are also active in this market. At present, the consumer credit market is also made up of other entities that do not have a banking license and are referred to as non-bank entities. According to Milne and Parboteeah (2016), due to the development of sharing economic industry the number of so-called Peer-to-peer lending platform increased in recent years. Those platforms apart from traditional regulation, combines demand and supply with consumer credit. Economic developments in recent years is coupled with lower interest rates and less strict regulation. It has enabled consumer credit to be extended to a wider range of people, leading to significant household indebtedness over the last nine years in Slovakia.

There are several academic contributions that deal with the credit market in Slovakia. Specific features of the Slovak banking sector can be studied in Horvátová (2014) and an impact of the crisis on the financial system of Visegrad countries is explored in Lawson and Zimková (2009). Majority of studies focused on a profitability, technical efficiency and competitiveness of the banks operating in Slovakia, e. g. Boďa and Zimková (2015), Boďa, Farkašovský and Zimková (2016), Palečková (2015), Zimková (2014), Horvátová (2017). Only some of them reflect also the quality of the banking services, e.g. Boďa and Zimková (2013), or Farkašovský and Pinter (2014). On the contrary, the papers on the financial services of non-banking sector are scarce in the academic literature. The aim of our contribution is to fill this gap as we aim to research the structure of consumer credit granted to households by both, banks and non-bank entities.

In this article, we focus on the analysis of consumer behavior and the structure of consumer credit granted to households by banks and non-bank entities, taking into account the volumes of new loans and their prices, expressed in interest rates and annual percentage rate of charge. At the same time, we evaluate the real effect of the tightened regulation on the consumer credit market for households in Slovakia.

2 Regulation of Consumer Credits in Slovakia

Rights and obligations related to the provision of consumer credits on the basis of consumer credit agreements has been regulated in Slovakia via separate legislative act since 2010. The area of consumer credit has been regulated by the Act No 129/2010 Coll. on consumer credits and other credits and loans for consumers and amending certain laws.

The framework of the consumer credit regulation between the years 2010 and 2015 could be characterized as a soft approach towards the rights and obligations of market participants, where the providers has not been limited in entering the market or product design. However, this soft approach has turned out to be too liberal for providers and led to many complaints from the side of consumers on applied practices and unfair conditions. This market development has led to the demand for a new regulatory framework on consumer credit, which became effective since April 2015 (and some parts afterwards).

However, the Act on consumer credits is not the only legislative framework regulating the consumer credit market in Slovakia. Additional legislative acts that have significant impact on the consumer credit market, consumer credit products and additional conditions, rights and obligations could be summarized as follows:

- § 52 - § 54 of the Civil Code,
- Act No. 129/2010 Coll. on consumer credits and other credits and loans for consumers and amending certain laws,
- Act No. 266/2005 Coll. on the protection of consumers in respect of the distance marketing of financial services (and amending certain laws)
- Act No 250/2007 Coll. on consumer protection.

The Civil Code as well as Act on Consumer credits points at the Regulation No 87/1995 Coll. of the Government of the Slovak Republic implementing certain provisions of the Civil Code, where the price regulation of the consumer credit products is presented.

Thus, we can generalize, that the consumer credit regulatory framework consists from five main legislative acts, which form the basis for organization of the consumer credit market and product design, distribution, pricing and market participant behavior.

Regulatory changes in 2015

In order to explain the regulatory changes after the April 2015, we have structured the text into several areas defining the consumer credit market:

- authorization (licensing) of the consumer credit providers (non-banking providers),
- price regulation (ceiling),
- pre-contractual obligations of providers,
- evaluation of creditworthiness and ability to repay the consumer credit,
- details of the consumer credit agreement, • information obligations for the purpose of regulation and supervision.

Main regulatory changes in 2016

Main regulatory changes in 2016 have been focused on tackling the issue of increased speed of indebtedness of households. Legislative changes defined under the Act No. 90/2016 Z.z. on Mortgage loans have changed the definition of consumer credit where also credits used for financing real estate where no real estate collateral is required fall under the scope of consumer credit. At the same time, for these types of consumer credits there is no limit for repayment, while for other types of consumer credit a maximum of 10 years is defined as the maximum length for which consumer credit can be offered.

However, significant influence on the consumer credit market have had the Act No. 299/2016 Z.z., which changes the Act on Consumer Credit. The dominant part of the act focuses on the introduction of measures oriented on the obligation of a creditor to assess the creditworthiness of the consumer before the consumer credit is approved as well as during the whole contract duration. The creditworthiness assessment is based on simple formula comparing the net monthly income of a consumer ("A") and minimum standard living costs ("B"), costs of a credit provided to a consumer ("C") and other obligatory monthly payments ("D"). Thus, the consumer credit can be provided under the condition that

$$A \geq B + C + D \quad (1)$$

At the same time, creditor has to take into account the impact of interest increases and shall not take into account expected increase of future consumer's income if this is not plausibly shown. The above mentioned Act also introduced the regulatory power for National Bank of Slovakia to issue detailed regulation on how to calculate all items A till D as well as the power to gather statistical data on provided consumer credit from credit providers on a regular basis and other oversight powers including the fines for consumer credit providers for breaching the obligations.

Main regulatory changes in 2017

Legislative changes in 2017 have been focusing on further tightening the introduced formula where the minimum living standard costs has been increased by a coefficient of 1,2 and thus increased the overall limit for consumer creditworthiness assessment. National Bank of Slovakia has issued its regulations which significantly influenced the ability to provide consumer credits. At the same time, National Bank of Slovakia has started preparing its regulation on overall limits implied on consumer credit providers. These regulations are expected to be effective starting July 2018.

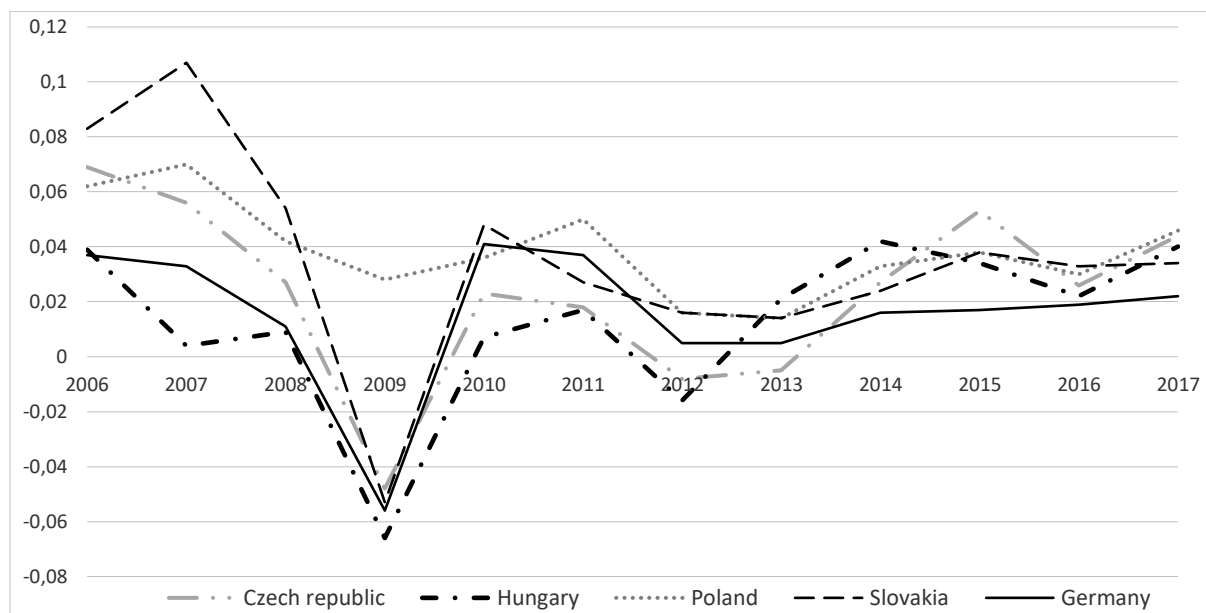
In the context of the above-mentioned legislative changes, we will look at the development of the consumer credit market in Slovakia in the context of banks and non-bank entities and the impact on the structure of the market.

3 Development and Changes in Consumer Credit Market in Slovakia

Economic development not only in Slovakia but also in the surrounding countries of the V4 region is characterized by a positive and stable growth rate since the outbreak of the financial and economic crisis in 2009. Information about real GDP growth rates in selected countries is shown in Figure 1. Positive Economic Growth is linked to the growth of economic activity, which is manifested by increased production of companies and household consumption. Economic developments in the last nine years have been coupled with the extensive fiscal stimulus of individual governments, supplemented by an expansionary monetary policy not only by the European Central Bank (ECB) but also by other central banks outside the Eurozone or in the world. Expansionary monetary policy has been associated with a reduction in key interest rates, which currently reach a zero level. The cost of credit has fallen and has become more accessible to consumers. The aim was to promote economic growth and increase consumption of households and companies.

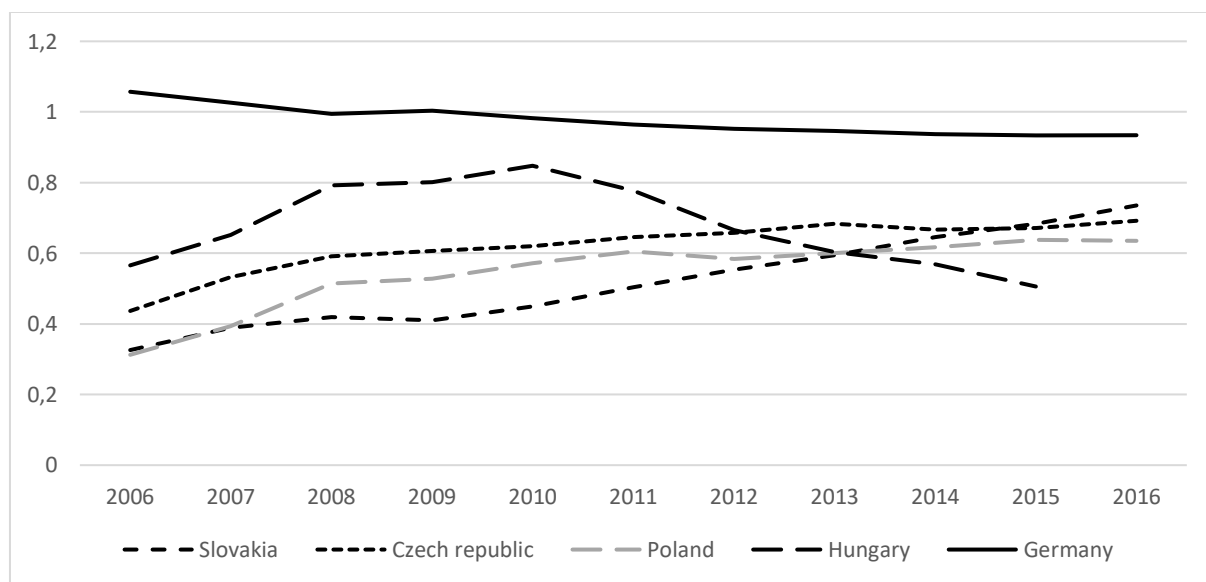
Household indebtedness can be characterized as the ratio of household debt to gross domestic product or as a ratio to their net disposable income. From our point of view, it is more appropriate to indicate household indebtedness as a ratio to the net disposable income of households. Figure 2 shows the evolution of indebtedness to household net disposable income between 2006 and 2016. Among the countries surveyed, Slovak households recorded the highest increase in indebtedness, which grew at 32,59 % in 2006 to 73,53 % in 2016. Higher the level of indebtedness has only the Germans among the countries surveyed. In 2016, it reached 93,41 %, a decrease of 12,31 pp compared to 2006.

Figure 1 Real GDP Growth in Selected Countries



Source: Eurostat, 2018

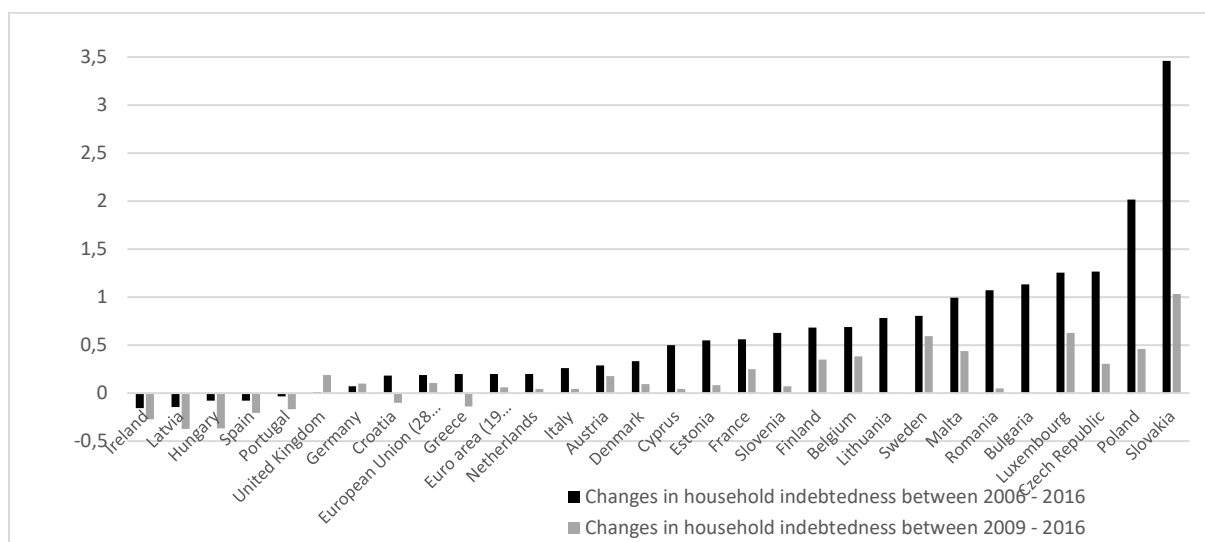
Figure 2 Household Total Debt of Net Disposable Income



Source: Eurostat, 2018

Figure 3 shows the change in household indebtedness of individual EU countries between 2006 and 2016 and 2009 to 2016. In both cases, Slovak households are among the countries with the highest growth. Between 2009 and 2016, household indebtedness grew by 103,45 %, up from 345,80 % between 2006 and 2016. The increase in household indebtedness in EU countries was only 19,04 %, and in the other 10,60 % and in the Eurozone countries it was 19,95 % respectively 5,85 %. The significant increase in household indebtedness in Slovakia was mainly due to its low level compared to the EU or Eurozone countries. Stable economic growth, disposable income growth, and low interest rates have created conditions for increasing households' lending capacity, which has also led to an increase in their indebtedness.

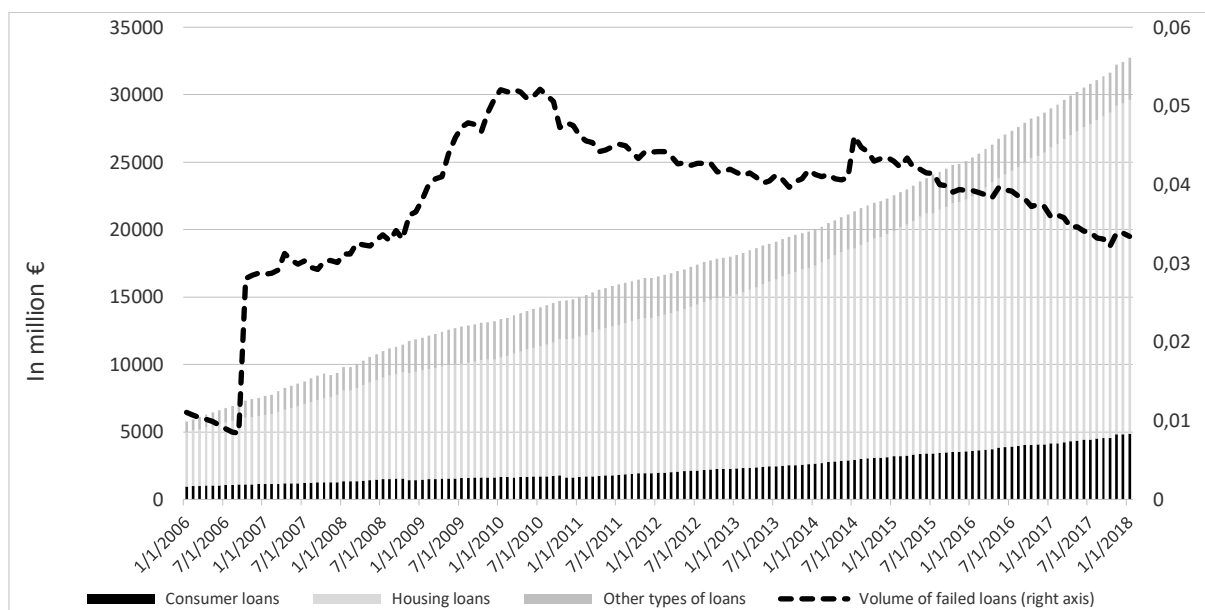
Figure 3 Changes in Household Indebtedness in EU Countries in Two Selected Tie Periods



Source: Eurostat, 2018.

Figure 4 shows an increase in the volume of loans granted to households, especially in the case of housing loans. Housing loans recorded an increase of 544,0 % over the monitored period, consumer credit 429,21 % increase and other types of loans 300,45 %. The growth of consumer credit provided mainly by banks is due to the growth of housing loans. Individuals very often, in the absence of their own savings, finance the purchase of real estate with consumer loans. Indeed, the rise in long-term indebtedness in the form of housing loans is problematic from the point of view of the regulator of the National Bank of Slovakia, especially in the period of low interest rates. At present, the limit for lending for housing has been reduced from 90 % to 80 % of the value of the property. Therefore, an individual need not the amount of 10 % but 20 % of the property price either in the form of own savings or by the drawing of consumer credit.

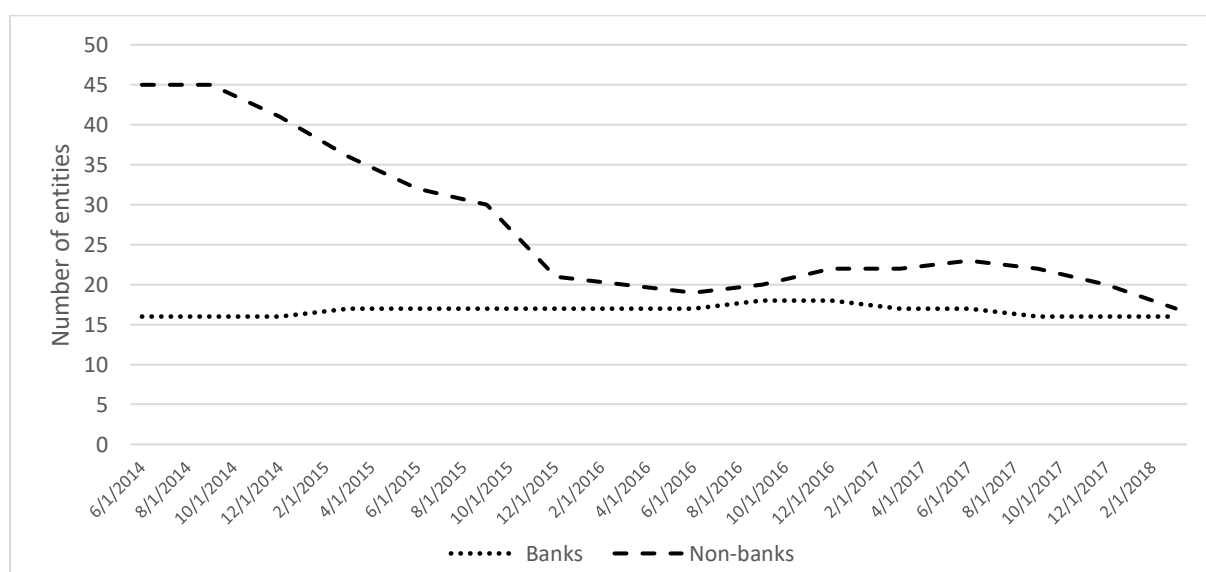
Figure 4 Structure of Loans Providing Household and Volume of Failed Loans in Slovakia in Monthly Bases from January 2006 to March 2018



Source: National bank of Slovakia, 2018.

The aim of the legislative changes mentioned in the second part of this article was to tighten the criteria for the provision of consumer credit by banks and non-bank entities. Figure 5 shows the development of the number of banks and non-bank entities providing consumer credit in Slovakia between 2014 and 2018 on a quarterly basis. Throughout the monitored period, we can see a slightly stable development in the number of banks that provided consumer credit. Their number oscillated between 16 and 18. In the case of non-bank entities, the development is more variable. We observe a stable number of non-bank entities in 2014, which began to decline from 1Q 2015. From the original 45 entities, this figure dropped to 30 in the 3Q 2015. In this period, the entities operating on this market had to go through licensing under the auspices of the National Bank Slovakia, if they wanted to stay on the consumer credit market. A more significant drop in 9 non-bank corporations is recorded in the 4Q 2015 when we can see that the consumer credit market has stabilized, and the market has remained subject to tighter consumer credit conditions. Between 1Q 2016 and 4Q 2017, the growth in the number of non-bank entities was stable and oscillated around 19-23 subjects. The new stricter conditions on the consumer credit market since 2018 have caused a further decline in the number of non-bank entities in the 1Q 2018 to 17 subjects.

Figure 5 Number of Entities Operating in Consumer Credit Market in Slovakia



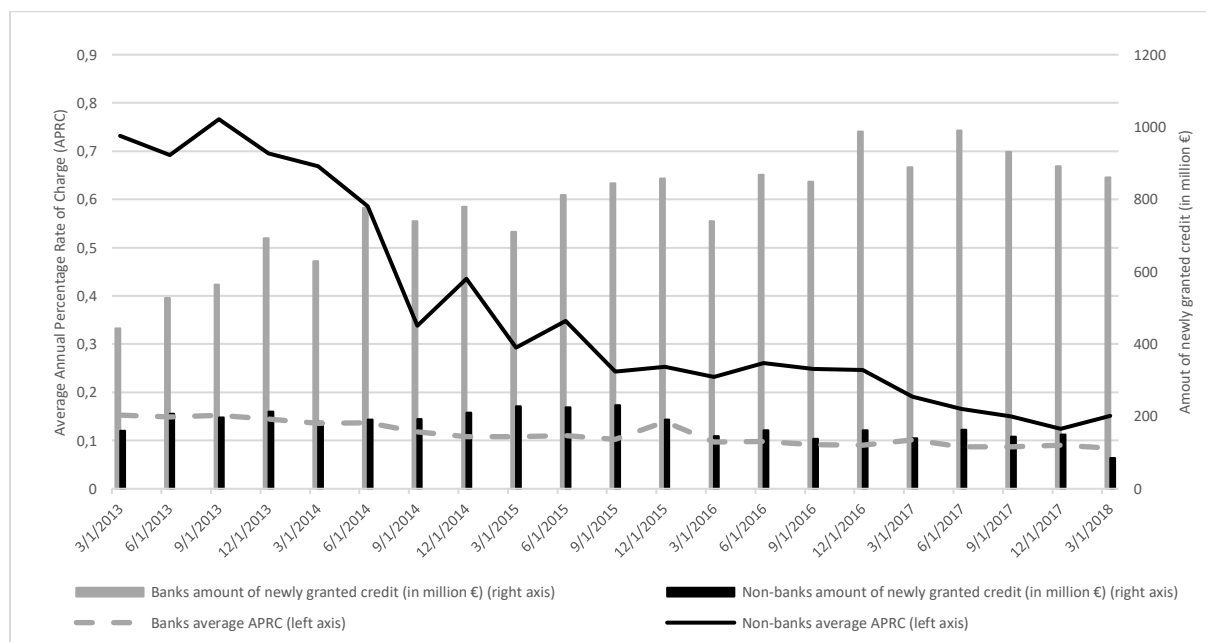
Source: National bank of Slovakia and Ministry of Finance Slovak republic, 2018.

In terms of the number of entities operating in the consumer credit market, the tightening of the terms of the consumer lending was reflected mainly in the decline of non-bank entities. Through Figure 6, we look at the volume of newly granted consumer credit by banks and non-bank entities from 1Q 2013 to 1Q 2018. Figure 6 also shows the average APRC average for consumer loans provided by banks and non-bank households in the reference period. This increase in household indebtedness is particularly noticeable for bank entities. The share of newly granted consumer credit by banks increased over the period under review compared to consumer credit provided by non-bank entities. In the case of non-bank entities, the decrease is visible especially since the 1Q 2015, when the number of non-bank entities in the Slovak market was significantly reduced and the conditions for the provision of consumer credit were tightened. The volume of newly provided consumer credit by non-bank loans decreased from the level of 231,05 mil. € in 3Q 2015 to the current 84,45 mil. € in 1Q 2018. In the case of banks, we see an increase from the level of 844,51 mil. € to 860,98 mil. €.

A diametrically different development is observed when looking at the average APRC. In the case of banks, we notice significantly lower levels of the average APRC throughout the reference period, which dropped from 15,26 % in 1Q 2013 to 8,43 % in 1Q 2018. In the case of non-bank entities, we see a significantly more volatile development of the average

APRC. In 2013 it oscillated between 69,19 % and 76,62 %. In 2014 it began to decline and ranged from 33,78 % to 66,88 %. In 2015, we see again the decrease in the average APRC, which in the following year 2016 shows values ranging from 23,22 % to 34,75 %. In 2017, the decline and convergence of the average APRC on consumer credit provided by non-banks to the average APRC covered by banks continued. For the 1Q 2018, the average APRC was 15,12 %, which is 6,69 % more for banks.

Figure 6 Development of Average APRC and Amount of Newly Granted Credit to Household (in million €) by Banks and Non-banks from 1Q 2013 to 1Q 2018



Source: authors' elaboration, 2018.

From the available public sources, it is not possible to obtain information on the number of clients who draw consumer loans in one year, so we do not discuss this area in the article.

4 Conclusions

In the article we analyze in detail developments in the consumer credit market in Slovakia with regard to a tightening regulation in the last three years. Slovak households have increased their indebtedness most significantly since the European Union. Narrow regulation of the consumer credit market has in recent years significantly reduced the number of non-bank entities operating in this market. The gap between consumer credit costs in APRC significantly decreased, which helped reduce the number of non-bank entities and clear the market from the so-called Predatory consumer credit providers. From the perspective of the client, we can talk about positive legislative changes between 2015 and 2017, which created the conditions for fair consumer credit provision. In our article, we could not fully evaluate the impact of the legislative changes affecting 2018, which lead to a more rigorous approach to assessing borrowers' credit capacity. That is why we want to continue in the field of research in this area. We would like to extend the survey with an analysis of the profitability of companies operating in the consumer credit market, supplement this list of companies with peer-to-peer lending companies, and map out the relationship between consumer credit growth, executions and personal bankruptcies.

References

Boda, M., Zimková, E. (2013). Service-oriented efficiency of Slovak banks. In: *7th International Days of Statistics and Economics*. Prague: University of Economics, pp. 164-172. ISBN 978-80-86175-87-4.

Bodá, M., Zimková, E. (2015). Efficiency in the Slovak banking industry: a comparison of three approaches. *Prague Economic Papers*, 24(4), pp. 434-451. DOI: <http://dx.doi.org/10.18267/j.pep.546>.

Bodá, M., Farkašovský, V., Zimková, E. (2016). Technical Efficiency and Profitability in Retail Production of Bank Branches. In: Palečková, I., Szarowská, I., eds., *Proceedings of the 15th International Conference on Finance and Banking*. Karviná: Silesian University, pp. 1-13.

Farkašovský, V., Pinter, Ľ. (2016). Quality and efficiency of bank branch services. In: *Proceedings of the 13th International Scientific Conference of the European Financial Systems 2016*. Brno: Masaryk University, pp. 141-148.

Horvátová, E. (2014). Development and characteristics of Slovak banking system. In: *Political sciences, law, finance, economics and tourism*. Book series: International Multidisciplinary Scientific Conferences on Social Sciences and Arts, vol. II, pp. 201-208.

Horvátová, E. (2017). Technical Efficiency of banks selected countries of Eastern Europe. In: *Proceedings of the 14th International Scientific Conference European Financial Systems 2017*. Brno: Masaryk University, pp. 251-257.

Lawson, C., Zimková, E. (2009). The Credit Crisis: What lesson for Visegrad? *Prague Economic Papers*, vol. 18(2), pp. 99-113. DOI: <http://dx.doi.org/10.18267/j.pep.344>.

Milne, A., Parboteeah, P. (2016). *The Business Models and Economics of Peer-to-Peer Lending*. European Credit Research Institute Research Report No. 17/May 2016.

Palečková, I. (2015). Efficiency change in banking sectors of Visegrad countries. In: *7th International Scientific conference*. Brno: Mendel University, vol. 12, pp. 780-787.

Zimková, E. (2014). Technical Efficiency and Super-Efficiency of the Banking Sector in Slovakia. In: *Proceedings of the 17th International Scientific Conference Enterprise and Competitive Environment*. Brno: Mendel University, vol. 12, pp. 780-787. DOI: 10.1016/S2212-5671(14)00405-5.

The Relationship between Debt and Equity in Social Economy Organizations – Polish Case

Grzegorz Michalski

Wroclaw University of Economics
Katedra Pracy i Kapitału
Komandorska 118, 53-345 Wroclaw, Poland
E-mail: Grzegorz.Michalski@ue.wroc.pl

Abstract: *In that paper is presented the model based on data about debt to equity relationship, collected from 5500 Polish social economy organizations in comparison to data from over 112000 European social economy organizations. Capital structure is an indicator that testify about level of financial risk. Polish social economy entities covered by Amadeus database, reports different debt to whole capital relationship customs. The levels of debt to whole capital reported in financial statements covered by Amadeus database in social economy entities in V4 and European countries were higher in the time financial risk 2007 - 2012 period than in Polish social economy entities. Polish social economy organizations are important part of general social policy in Polish economy. They realize important aims in healthcare, in education and many other socially important areas. Considering efficiency of social economy organizations, should be remembered that from the donor perspective, is important the way the managing team uses resources of the social economy organization and if it is used in the most effective way. The social economy organization efficiency should be considered in the context of the risk. The one from the most important way to be out from business is the debt to equity relation. In paper are considered relations between debt measures and efficiency measures. That relation is also illustrated for Polish social economy organizations data.*

Keywords: *equity, capital structure, nonprofit organizations, efficiency of social economy organizations*

JEL codes: *G30, G31, G32*

1 Introduction

Grizzle et. al. (2015) examine organizational factors that impact the level of operating reserves in social economy organizations and explore the relationship of operating reserves with organizational demographics and financial health variables (Grizzle et. al., 2015). T Kuo et. al. (2014) noticed that Magnus et al. (2003) and Yetman (2007) argued that debt financing would have a negative impact on the charitable donations of social economy entities (Kuo et. al., 2014). Kuo et. al. (2014) investigate the relationship between debt financing and donation levels and according to Kuo et. al. (2014) empirical results, was proved that debt financing has both a crowd-in effect and crowd-out effect on social economy entities donations. Kuo et. al. (2014) show that the crowd-in effect tends to exist in low debt ratio social economy entities, and the crowd-out effect is often found to exist in not-for-profit social economy entities with higher debt ratios (Kuo et. al., 2014). Tuckman and Chang (1993) analyses why social economy entities accrue debt and whether the funds they borrow are used productively. Work of Tuckman and Chang (1993) distinguishes between productive, problematic, and deferred debt. Tuckman and Chang (1993) examine the pervasiveness of social economy debt and the relation between this debt and social economy financial health and they find that over 70 percent of the social economy entities hold debt, the distribution of this debt is highly concentrated, and the level of debt and leverage varies with asset size and type of activity what is in one accord with findings of that paper (Tuckman, Chang, 1993). Social economy entities with higher debt levels are financially healthier than those with lower levels (Tuckman, Chang, 1993), (Gavurova et. al., 2018)

Prentice (2016a) explores the organizational and environmental factors that affect social economy financial health (Prentice, 2016a). Turner et. al. (2015) focused on the differential use of debt financing among forprofit and social economy entities. Forprofit entities use significantly and substantially more debt than social economy entities (Turner et. al., 2015). Calabrese (2011) analyzed the static trade-off and pecking order capital structure theories and applied to social economy organizations. Calabrese (2011) also considers how social economy entities adjust their debt to equity relation over time. Calabrese (2011) indicates that social economy capital structure choices are best explained using the pecking order theory, in which internal funds are preferred over external borrowing (Calabrese, 2011). Rosen and Sappington (2016) investigate the decisions of social economy entities to issue debt and they test whether the expected value and uncertainty of a social economy entity nonfinancial income affect its capital structure (Rosen, Sappington, 2016). Rosen and Sappington (2016) find that debt to equity increase is negatively related to both the expected value and the uncertainty (Rosen, Sappington, 2016).

Szymanska and Jegers (2016) theoretically describe social enterprises taking into consideration their main aims and they point out the direction which social enterprises should follow in order to obtain the highest value of their objective functions (Szymanska, Jegers, 2016). Wedig (1994) points that social economy entities are similar to proprietary firms except that their financial residual is expensed on a philanthropic activity which is similar to a dividend-in-kind for a donors (Wedig, 1994). Wedig (1994) shows how the constraint against paying cash dividends affects the intertemporal paths of capital structure and argue that the social economy entities dividend-in-kind are similar to dividends in for-profit firms. Social economy entities are risk averse over cash flows and fund balance and behaves like a risk averse consumer rather than a risk neutral firm (Wedig, 1994). Wedig (1994) used a dynamic model to derive closed form expressions for the time paths of debt and in comparison with empirical data Wedig (1994) confirms the hypothesis of risk aversion.

Long (1976) finds that debt to equity decisions must be based on many inputs—including financial valuation, which has not traditionally been applied in the social economy entities sector (Long, 1976). Reiter et. al. (2000) claims that in capital structure decisions of social economy entities play the same rules as in for profit entities (Zietlow, 1989).

Copeland and Smith (1978) make suggest that social economy entities that are donor funded have the primary objective of donor utility maximisation to ensure that the resources provided by the donor are utilised in the most efficient manner possible (Copeland, Smith, 1978), (Strydom, Stephen, 2014). Upadhyay et. al. (2015) studied the relationship between the social economy entity profitability and cash tied in operational activity (Upadhyay et. al., 2015; Blendinger, Michalski, 2018).

Rauscher and Wheeler (2012) claims that increased financial pressures on social economy entities have elevated the importance of working capital management. Efficient working capital management allows social economy entities to reduce their holdings of current assets and cash inflows can be used to reduce borrowing (Rauscher, Wheeler, 2012). Rauscher and Wheeler (2012) examine the relationship between social economy entities profitability and their performance at managing accounts payable (Rauscher, Wheeler, 2012). Singh and Wheeler (2012) investigate used data for 1,397 bond-issuing, not-for-profit US entities for 2000 to 2007, and Singh and Wheeler (2012) analyzed the relationship between social economy entities performance at managing the revenue cycle and their profitability and ability to build equity capital (Singh, Wheeler, 2012). Singh and Wheeler (2012) model four different measures of profitability and equity capital as functions of two key financial indicators and their results indicated that higher amounts of revenue in relation to a social economy entity assets were associated with statistically significant increases in equity capital ($p < 0.01$ for all four models). Singh and Wheeler (2012) claims that social economy entities that generated more revenue per assets invested reported improved financial performance (Singh, Wheeler, 2012). Statistically significant link existed between lower revenue collection periods and equity ($p < 0.01$ for three models; $p < 0.05$ for one model): social economy entities that collected faster on their revenue

reported larger equity values (Singh, Wheeler, 2012). Findings of Singh and Wheeler (2012) means that social economy organization can advance the financial viability by improving profitability and enabling equity growth (Singh, Wheeler, 2012).

Wheeler and Smith (1988) show that the appropriate discount rate for evaluation of capital expenditures depends on risk, leverage, cost-based reimbursement. Method presented by Wheeler and Smith (1988) can be used to account for these effects that is both practical and consistent with theory (Wheeler, Smith 1988). Wacht (1978) deals with the financial problem of integrating debt financing and fund-raising campaigns in social economy equities. Objective of Wacht (1978) findings is the model of the capital budgeting process for social economy entities. Social economy institutions, as claims Wacht (1978) cannot use orthodox cost-benefit tests because they are inappropriate and impractical because of the multi-dimensional character of the capital structure decision (Wacht, 1978), (Bem et. al., 2017).

Trussel (2012) claims that a capital structure used by social economy entities is an important determination of financial risk. Trussel (2012) indicates that there is no difference in the amount of leverage between the two institutional types of NGO's. Social economy and social economics entities have unique financing mechanisms which do not impact the relative amount of debt and equity in their capital structures (Trussel, 2012). Woronkowicz (2016) investigates social economy financial vulnerability metrics resulted from the effect of a capital facilities project. Woronkowicz (2016) uses data for a sample of social economy organizations and models the relationship between financial vulnerability indicators and facilities investments. The findings of Woronkowicz (2016) are evidence for fact that investments in facilities are associated with the costs of debt associated with facilities projects and influence social economy finances. The Woronkowicz (2016) findings have implications for the financial management of social economy organizations costs of capital (Woronkowicz, 2016).

Wacht (1984) claims that characteristics of social economy entities prevent the transfer and successful application of standard financial management solutions to financial management decisions in the social economy context (Wacht, 1984). Such characteristics include a dual management structure composed of professional and financial managers (Wacht, 1984), restrictions on the disposition of assets and earnings, and the constant threat of illiquidity as the result of the uncoupling of organizational goals and cash flows (Wacht, 1984). The theory of financial management separates the financial management goals from the professional goals (Wacht, 1978). A social economy entity can survive financially through time while its professional manager pursues utility-denominated goals delineated by the organization's tax-exempt status (Wacht, 1978).

Tuckman and Chang (1992) claims that social economy decisionmakers have an incentive to earn and accumulate surpluses. Tuckman and Chang (1992) developed a behavioral model and used to derive a demand function for equity. Tuckman and Chang (1992) applied such model to a national sample of 6168 charitable social economy entities and establish the hypothesis that social economy decisionmakers consciously plan to increase their organization's equity (Tuckman, Chang, 1992).

Prentice (2016b) claims that financial measures are used in social economy research to predict funding opportunities. The findings of Prentice (2016b) suggest that using debt to equity measures in social economy entities do not guarantee to find the searched answer (Prentice, 2016b).

Social economy organization may be defined as the entity that is concerned in its actions about realization of social value adding mission. Such mission is realized thanks to sources collected thru donations from donors (Michalski, 2016b). Donor is an individual (person, firm, other entity) who appreciate social value generated by realization of the mission realized by social economy organization. Such appreciation results in supporting social economy organization by donor's donations. Donation is a supporting of social economy organization actions amount of money, other assets or volunteer work that donor delivers to supported social economy organization (Michalski, 2016a). Presented discussion

contributes in corporate finance theory in its narrower area concerned about social economy organizations model of financial management in financial liquidity with efficiency measures as the context. That context is seen by some as controversial, especially from technical point of view. Some claim that social economy finance and its managerial decisions in them, are not different from for-profit business decisions (Hansmann, 1987, Jegers, 2011; Michalski, 2016c, Gavurova, Korony, 2016). Such position is only partially correct. Sloan et al. and Wedig et al. use with modifications financial management portfolio theory to social economy organization financial management (Sloan et al., 1988; Wedig 1994, Wedig et al. 1996, Jegers, Verschueren, 2006; Soltes, Gavurova, 2015). In the paper is used the model of financial debt management in social economy organizations from the perspective that states the fundamental financial target of social economy organization is the best financially effective implementation of the mission that cause the donors support for the social economy organization (Leone, Van Horn, 2005; Eldenburg, 2011; Gavurová, Šoltés, 2014). Social economy organization financial debt management decisions need to take in account relation between future effects in the context of risk as debt financing is a specific form that increase financial risk (Soltes 2010, Bem, Michalski, 2015). That perspective is close to creation of for-profit firms value (Michalski, 2016a; Chapelle, 2010; Siedlecki, Bem, 2016).

2 Results and Discussion

Polish social economy entities covered by Amadeus database, reports different debt to whole capital relationship customs. Social economy organization managing team decision about the financial debt level policy, is a balance of gaining new opportunities to serve thru realization of the mission. That kind of decision shapes the level and quality of financial debt (Michalski, 2012). Paraphrasing Keith Smith and James A. Gentry observations, is possible to observe that Robichek et al. (Gentry, 1988; Robichek et al., 1965; Smith, 1973) tell about risk involved to financial debt level decisions, which must be accepted by financial institutions pledging of financial debt level of the nonprofit organization. Keith Smith (Smith, 1973; Gentry, 1988) predicted and Michalski (Michalski, 2008; Michalski, 2012) showed how portfolio theory may be used to decrease financial debt level risk. Debt to equity could be viewed in portfolio context as presented by Friedland (1966; Gentry, 1988). Pringle and Cohn (1974; Gentry, 1988) tried to adapt the CAPM theory to capital elements. Bierman and Hausman (1970; Gentry, 1988) discuss the granting policy of organization and shows that financial debt level policy requires balancing the future sales gains against possible losses. Lewellen, Johnson and Edmister (Lewellen, Johnson, 1972; Lewellen, Edmister, 1973) explain how and why traditional devices used for monitoring financial debt level should be changed by new and better ones. Freitas (Freitas, 1973) shows relation between debt and risk during financial debt level management. The question discussed in presented paper concerns the making decisions by nonprofit organizations in financial debt level area in connection with efficiency measures (Michalski 2016b).

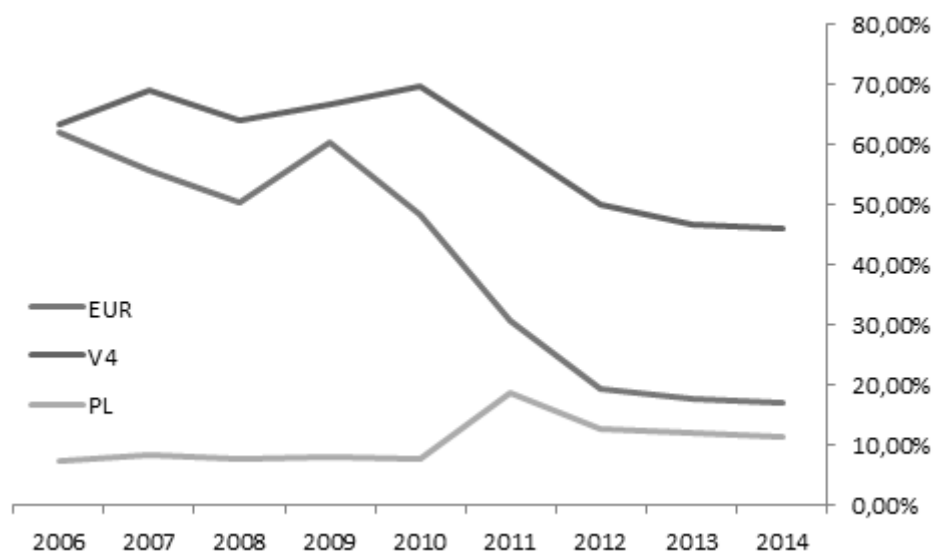
Table 1 The Relationships between Debt and Whole Capital in European, V4 and Polish Social Economy Entities

	2015	2014	2013	2012	2011	2010	2009	2008
EUR	36,20%	17,16%	17,75%	19,25%	30,66%	48,29%	60,39%	50,27%
V4	78,38%	45,92%	46,89%	50,17%	59,97%	69,66%	66,74%	64,24%
PL	17,82%	11,53%	11,99%	12,68%	18,56%	7,66%	8,07%	7,84%

Source: Database Amadeus product of Bureau van Dijk, [date: 2017 MAY 15]

As we can observe in Table 1. and Figure 1, the levels of debt to whole capital in social economy entities in V4 and European countries were higher in the time financial risk 2007 - 2012 period. That levels in Polish social economy entities looks different and that is an interesting observation, which illustrate general tendency of Polish social economy entities covered by Amadeus Database (probably also it is the truth also for whole population for Polish social economy entities).

Figure 1 DEBT to Capital Invested (Debt + Equity) Levels in Chosen European Social Economy Organizations



Source: own study based on data from 112000 social economy organizations reported in Database Amadeus product of Bureau van Dijk, [date: 2017 MAY 15]

There is difference in treating the entitlements of people who control organizations in prohibiting distribution of earnings and excess of revenues over expenses of organization: Equity type capital providers of for-profit firms can expect return money in case the business makes excess of revenues over expenses from operations. Social economy organizations do not have right to issue stock and equity of social economy organizations is issued by donors and persons who have no right to express control over the social economy organization. Equity type capital providers of social economy organizations in case the social economy organization generates money or excess of revenues over expenses from operations can consider additional support for organization but have no possibility to withdraw the money previously tied in organization. In social economy organizations, there is no equity capital but social economy organizations collect fund capital which is an equivalent of equity capital. Fund capital is collected in social economy organizations by earning excess of revenues over expenses, that are forced by regulation as money which should be retained within the social economy organization. Other source of fund capital is receiving contributions from individual persons or from private or public entities and from for profit businesses. The last possibility to collect fund capital are money from grants received by social economy organizations from governmental entities. Calabrese (2011) indicates that social economy capital structure choices are best explained using the pecking order theory. That means that in social economy organizations internal funds are used more likely than external borrowing.

Social economy organizations act because expected future advantages measured by realization of ideas and mission that are expression of donor's vision of the world. Both social economy and for-profit entities have an aim, which is a result of its owner preferences. For-profit organizations are active because of expected future advantages measured in money, non-profit organizations do their business because of expected future advantages measured by degree of realization of their mission.

Social economy organizations serve in each areas of social activities and depending on size can be registered or not in internal revenue authorities. Among social economy organizations can be listed: educational businesses like universities or schools, healthcare organizations like hospitals, charities working as religion institutions branches, etc.

Because of the benefits to the society generated by social economy organizations most governments allow tax exemptions both for donors and for the social economy organizations. Such tax exemptions are usually limited only to charitable social economy

organizations, which are listed on government records of such organizations that meet the condition for tax exemptions. Usually governments decide that according to their policy only the largest and the most useful for fixing society needs and most helpful for the people of society organizations have right for tax exemptions and of course the definitions and understanding of usefulness or helpfulness differ from country to country, and depends on dominating philosophy or religion of local societies (Michalski, 2016b). Tax exemption for the social economy organization could be for all money generated as profit in these organizations but more popular is solution where only profits that are effect of realization of programs or activities concerned on realization of the main mission of social economy organization are basis for tax exemption and other profits are subject of normal taxation. Such a solution helps to prevent situation when under social economy banner is hidden full for-profit activity not concerned on social needs and is not of help in leveling of disabilities of weaker participants of social interaction. Usually social economy organizations to keep tax exemption status are required to keep all excess revenues for the realization of the mission of social economy organization. There is not a custom among governments to allow social economy organizations to pay out money from excess of revenues over expenses to anyone who normally deserve it in for-profit entities. Board members, employees and clients of social economy organizations are excluded from receiving money that are larger than average expenses. Each amount of any money in social economy organizations should be directed to beneficiaries defined by the mission of social economy organization (Michalski, 2016b).

3 Conclusions

Polish social economy organizations are important part of general social policy in Polish economy. They realize important aims in healthcare, in education and many other socially important areas. Considering efficiency of social economy organizations, should be remembered that from the donor perspective, is important the way the managing team uses resources of the social economy organization and if it is used in the most effective way. The social economy organization efficiency should be considered in the context of the risk. The one from the most important way to be out from business is the lack of the money for realization of the aim of organization. In paper were considered relations between debt measures. That relation was also illustrated for Polish social economy organizations data.

Polish social economy entities covered by Amadeus database, reports different debt to whole capital relationship customs. Debt to whole capital levels in social economy entities in V4 and European countries were higher in the time financial risk 2007 - 2012 period. That levels in Polish social economy entities looks different and that is an interesting observation, which illustrate general tendency of Polish social economy entities covered by Amadeus Database (probably also it is the truth also for whole population for Polish social economy entities). After 2014 such tendency was changed in Polish social economy entities. Current policy of Polish **social economy** entities, that allows to use too much debt, is rather dangerous, and there is a need to increase level of understanding about risk and its destroying influence on possibilities of realization **social economy** organization mission.

Acknowledgments

The presented work and results is part of monothematic cycle realized as part of grant titled: Determinants of capital structure in social economy organizations. The work is supported by National Science Centre, and financed from the Polish budget resources in the years 2016-2019 according to contract UMO-2015/19/B/HS4/01686 as the research project DEC-2015/19/B/HS4/01686.

References

Bem, A., Michalski, G., (2015). Hospital profitability vs. selected healthcare system indicators. In: *CEFE 2015–Central European Conference in Finance and Economics*. Herlany: Technical University of Košice, pp. 52-61.

- Bem A., Siedlecki R., Ucieklak-Jeż P. (2017). Model of Hospitals' Financial Distress Forecasting: Comparative Study, In: *New Trends in Finance and Accounting. Proceedings of the 17th Annual Conference on Finance and Accounting*. Springer International Publishing, vol. 1, pp. 709-721. ISBN 9783319495590. DOI: 10.1007/978-3-319-49559-0_65.
- Bierman H., Hausman, W. H. (1970). The Vredit Granting Decision. *Management Science*, vol. 16(8), pp. B519-532.
- Blendinger, G., Michalski, G. (2018). Long-Term Competitiveness Based on Value Added Measures as Part Of Highly Professionalized Corporate Governance Management of German Dax 30 Corporations. *Journal of Competitiveness*, vol. 10(2), pp. 5-20. DOI: <https://doi.org/10.7441/joc.2018.02.01>.
- Calabrese, T. (2011). Testing Competing Capital Structure Theories of Social economy Organizations. *Public Budgeting and Finance*, vol. 31(3), pp. 119-143. DOI: 10.1111/j.1540-5850.2011.00989.x.
- Chapelle K., (2010). Non-profit and for-profit entrepreneurship: a trade-off under liquidity constraint. *International Entrepreneurship and Management Journal*, vol. 6(1), pp. 55-80. DOI: 10.1007/s11365-007-0071-y.
- Copeland, T., Smith, K. (1978). An overview of social economy organizations. *Journal of economics and business*, vol. 30(2), pp. 147-154.
- Eldenburg L. G., Gunny K. A., Hee K. W., Soderstrom N. (2011). Earnings management using real activities: evidence from social economy hospitals. *The Accounting Review*, vol. 86(5), pp. 1605-1630.
- Friedland S. (1966). *The Economics of Corporate Finance*. Eglewood Clifs, New Yersey: Prentice – Hall.
- Gavurova, B., Bacik, R., Fedorko, R., Nastisin, L. (2018). The Customer's Brand Experience in The Light of Selected Performance Indicators in The Social Media Environment. *Journal of Competitiveness*, vol. 10 (2), pp. 72-84. DOI: <https://doi.org/10.7441/joc.2018.02.05>
- Gavurova, B., Korony, S., (2016). Efficiency of day surgery in Slovak regions during the years 2009-2014. *Economic Annals-XXI*, vol. 159(5-6), pp. 80-84.
- Gavurová, B., Šoltés, M., Balloni, A. J., (2014). The economic importance of using of ICT in the health system. *Ekonomicky casopis*, vol. 62(1), pp. 83-104.
- Gentry J. A. (1988). State of the Art of Short-Run Financial Management. *Financial Management*, vol. 17(2), pp. 41-57.
- Grizzle, C., Sloan, M., Kim, M. (2015). Financial factors that influence the size of social economy operating reserves. *Journal of Public Budgeting, Accounting and Financial Management*, vol. 27(1), pp. 67-97.
- Hansmann, H. B. (1987). Economics theories of social economy organization. In: Powell, W. W., ed., *The social economy sector: a research handbook*. New Haven, CN: Yale University Press, pp. 27-42.
- Holmstrom, B., Tirole, J., (1996). Modeling Aggregate Liquidity. *The American Economic Review*, vol. 86(2), pp. 187-191.
- Holmstrom, B., Tirole, J., (2000). Liquidity and Risk Management. *Journal of Money, Credit and Banking*, vol. 32(3), part 1, pp. 295-319.
- Holmstrom, B., Tirole, J. (2001). LAPM: A Liquidity-Based Asset Pricing Model. *The Journal of Finance*, vol. 56(5), pp. 1837-1867.
- Jegers, M. (2011). Financing constraints in social economy organisations: A Tirolean approach. *Journal of Corporate Finance*, vol. 17, pp. 640-648.

- Jegers, M., Verschueren, I. (2006). On the capital structure of non-profit organisations: an empirical study for Californian organisations. *Financial Accountability and Management*, vol. 22(4), pp. 309-329.
- Kuo, J., Ho, Y., Lo, K. (2014). The relation between debt financing and not-for-profit hospitals' donations. *NTU Management Review*, vol. 24(2), DOI: 10.6226/NTURM2014.MAY.R11006, pp. 151-180.
- Leone, A. J., Van Horn, R. L., (2005). How do social economy hospitals manage earnings?. *Journal of Health Economics*, vol. 24, pp. 815-837.
- Lewellen, W. G., Edmister, R. O. (1973). A General Model for Accounts Receivable Analysis and Control. *Journal of Financial and Quantitative Analysis*, March, pp. 195-206.
- Lewellen W. G., Johnson, R. W. (1972). Better Way to Monitor Accounts Receivable. *Harvard Business Review*, May-June, pp. 101-109.
- Long, H. (1976). Valuation as a criterion in not-for-profit decision-making. *Health Care Management Review*, vol. 1(3), pp. 34-46.
- Magnus, S., Smith, D., Wheeler, J. (2003). Agency implications of debt in not-for-profit hospitals: A conceptual framework and overview. *Research in Healthcare Financial Management*, vol. 8(1), pp. 7-17.
- Michalski, G., (2008). Operational risk in current assets investment decisions: Portfolio management approach in accounts receivable. *Agricultural Economics*, vol. 54(1), pp. 12-19. Retrieved from: <http://ssrn.com/abstract=1562672>.
- Michalski, G., (2016). Full operating cycle influence on the food and beverages processing firms characteristics. *Agricultural Economics – Zemědělská ekonomika*, vol. 62(2), pp. 71-77.
- Michalski, G., (2016). Social economy Organizations. *Global Encyclopedia of Public Administration, Public Policy, and Governance*, pp 1-5.
- Michalski, G., (2016). Risk pressure and inventories levels. Influence of risk sensitivity on working capital levels. *Economic Computation and Economic Cybernetics Studies and Research*, vol. 50(1), pp. 189-196.
- Prentice, C. (2016a). Understanding Social economy Financial Health: Exploring the Effects of Organizational and Environmental Variables. *Social economy and Voluntary Sector Quarterly*, vol. 45(5), pp. 888-909. DOI: 10.1177/0899764015601243.
- Prentice, C. (2016b). Why So Many Measures of Social economy Financial Performance? Analyzing and Improving the Use of Financial Measures in Social economy Research. *Social economy and Voluntary Sector Quarterly*, vol. 45(4), pp. 715-740. DOI: 10.1177/0899764015595722.
- Pringle, J. J., Cohn, R. A. (1974). Steps Toward on Integration of Corporate Financial Theory. In: Smith, K. V., ed., *Readings on the Management of Working Capital*. St. Paul, Minnesota: West Publishing Company.
- Ranjith Appuhami, B. A., (2008). The Impact of Firms' Capital Expenditure on Working Capital Management: An Empirical Study across Industries in Thailand. *International Management Review*, vol. 4(1), pp. 8-21.
- Rauscher, S., Wheeler, J. (2012). The importance of working capital management for hospital profitability: Evidence from bond-issuing, not-for-profit U.S. hospitals. *Health Care Management Review*, vol. 37(4), pp. 339-346. DOI: 10.1097/HMR.0b013e3182224189.
- Reiter, K., Smith, D., Wheeler, J., Rivenson, H. (2000). Capital investment strategies in health care systems. *Journal of Health Care Finance*, vol. 26(4), pp. 31-41.
- Robichek, A. A., Teichrow, D., Jones, J. M. J. M. (1965). Optimal Short – Term Financing Decision. *Management Science*, vol. 12(1), pp. 1-36.

- Rosen, H., Sappington, A. (2016). To borrow or not to borrow? An analysis of university leverage decisions. *Research in Economics*, vol. 70(1), pp. 170-185. DOI: 10.1016/j.rie.2015.10.005.
- Shin, H. H., Soenen, L. (1998). Efficiency of working capital management and corporate profitability. *Financial Practice and Education*, vol. 8(2), pp. 37-45.
- Siedlecki, R., Bem, A., (2016). Rural Versus Urban Hospitals in Poland. Hospital's Financial Health Assessment. *Procedia-Social and Behavioral Sciences*, vol. 220, pp. 444-451.
- Singh, S., Wheeler, J. (2012). Hospital financial management: What is the link between revenue cycle management, profitability, and not-for-profit hospitals' ability to grow equity?. *Journal of Healthcare Management*, vol. 57(5), pp. 325-339.
- Sloan, F. A., Valvona, M., Hassan, M., Morrissey, M. A., (1988). Cost of capital to the hospital sector. *Journal of Health Economics*, vol. 7(1), pp. 25-45.
- Smith, K. V. (1973). State of the art of working capital management. *Financial Management*, vol. 2, pp. 50-55.
- Soltes, V. (2004). Duration of coupon bonds as a criterion of the price sensibility of bonds with regards to the change of interest rates (Durácia kupónovej obligácie ako kritérium cenovej citlivosti obligácie vzhľadom na zmenu úrokových sadzieb in Slovak). *Ekonomický časopis*, vol. 52/2004(1), pp. 108-114.
- Soltes, V. (2012). Paradigms of Changes in the 21th Century - Quest for Configurations in Mosaic. *Ekonomický časopis*, vol. 60/2004(4), pp. 428-429.
- Soltes, M., Gavurova, B. (2015). Quantification and Comparison of Avoidable Mortality – Causal Relations and Modification of Concepts. *Technological and Economic Development of Economy*, vol. 21(6), pp. 917-938.
- Strydom, B., Stephen, T. (2014). Financial Management in Non-Profit Organisations: An Exploratory Study. *Mediterranean Journal of Social Sciences*, vol. 5(15), pp. 55-66.
- Szymanska, A., Jegers, M. (2016). Modelling Social Enterprises. *Annals of Public and Cooperative Economics*, vol. 87(4), pp. 501-527. DOI: 10.1111/apce.12127.
- Tuckman, H., Chang, C. (1992). Social economy equity: A behavioral model and its policy implications. *Journal of Policy Analysis and Management*, vol. 11(1), pp. 76-87.
- Tuckman, H., Chang, C. (1993). How well is debt managed by nonprofits?. *Social economy Management and Leadership*, vol. 3(4), pp. 347-361.
- Turner, J., Broom, K., Elliot, M., Lee, J. (2015). A comparison of capital structure: The use of debt in investor owned and not-for-profit hospitals. *Journal of Health Care Finance*, vol. 41(4).
- Upadhyay, S., Sen, B., Smith, D. (2015). The cash conversion cycle and profitability: A study of hospitals in the state of Washington. *Journal of Health Care Finance*, vol. 41(4).
- Wacht, R. (1984). A Financial Management Theory of the Social Economy Organization. *Journal of Financial Research*, vol. 7(1), pp. 37-45. DOI: 10.1111/j.1475-6803.1984.tb00352.x.
- Wacht, R., (1978). A capital budget planning model for social economy hospitals. *Inquiry*, vol. 15(3), pp. 234.
- Wedig, G. J., Hassan, M., Morrissey, M. A. (1996). Tax-exempt debt and the capital structure of social economy organizations: an application to hospitals. *Journal of Finance*, vol. 51(4), pp. 1247-1283.
- Wedig, G. (1994). Risk, leverage, donations and dividends-in-kind: A theory of social economy financial behavior. *International Review of Economics and Finance*, vol. 3(3), pp. 257-278. DOI: 10.1016/1059-0560(94)90011-6.

Wheeler, J., Smith, D. (1988). The discount rate for capital expenditure analysis in health care. *Health Care Management Review*, vol. 13(2), pp. 43-51.

Woronkowicz, J., (2016). Is Bigger Really Better?: The Effect of Social economy Facilities Projects on Financial Vulnerability. *Social economy Management and Leadership*, vol. 27(1), pp. 79-94. DOI: 10.1002/nml.21209.

Yetman, R. (2007). Borrowing and debt, Financing Nonprofits: Putting Theory into Practice. Lanham, MD: AltaMira Press, pp. 243-268.

Zietlow, J. (1989). Capital and Operating Budgeting Practices in Pure Social economy Organizations. *Financial Accountability and Management*, vol. 5(4), pp. 219-232.